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### A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"To the solid ground
Of Nature trusts the mind which builds for age."—Wordsworth.

### SATURDAY, JULY 2, 1927.

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### Scientific Worthies.

XLV -- RICHARD WILLSTÄTTER.

"For all flesh is as grass"—1 Peter i. 24.

"A child said, What is the grass? fetching it to me

with full hands; How could I answer the child? I do not know

what it is any more than he. I guess it must be the flag of my disposition, out

of hopeful green stuff woven.

"Or I guess the grass is itself a child, the produced babe of the vegetation.

Or I guess it is a uniform hieroglyphic

And it means, Sprouting alike in broad and narrow zones.

"And now it seems to me the beautiful uncut hair of graves."

WALT WHITMAN, Leaves of Grass.

HEMISTRY is both a craft and an art, one of the finest of arts-perhaps the art of arts, a veritable "sword of Aklis," wherewith the threads are cut which hold the secrets of our material world and the nature and character of its component units disclosed; it has a wondrous psychology of which but few as yet have gained feeling, mastery and reverence. A science only in the second degree, because so much of its burden cannot be quantified, chemistry is none the less a premier science, through the exquisite finish of the enviable craftsmanship exercised by the men of genius who have been successful in its service. Among the craftsmen who have most adorned our ranks, we can place none higher than the subject of this memoir, for he has reached to the highest pinnacle of technical proficiency to which our art has been carried. A striking

feature in his conquests has been the sureness and swiftness of his approach, the courage of his attack and his deft handling of situations which previous workers have failed to master.

A biographer writes · 1 " It is an open secret to the few who know it but a mystery and a stumbling block to the many, that Science and Poetry are twin sisters: insomuch that in those branches of scientific inquiry which are most abstract, most formal and most remote from the grasp of the ordinary sensible imagination, a higher power of imagination akin to the creative instinct of the poet is most needed and most fruitful of lasting work "

The chemist who can teach so much of grass, who can go so far towards answering the question put by the child to which the poet confessedly had no answer, who can also lay bare the secret of colour in flowers, may be placed even above the poet. The poet but deals with the superficial and with fancies; at best he is a mere painter. The full beauty of Nature, the structure of her wondrous mechanism, is patent only to the chemist: he is fast learning to interpret her 'uniform hieroglyphie' in terms which admit of no dispute. Now that we can think in terms of the Ångström unit, our vision is become ultramicroscopie. Our science of chemistry, in fact, is no twin sister of poetry but poetry itself and at its highest. Its mysteries are as deserving of attention and as marvellous as are those of even the densest stars. Indeed, the saga of the universe is before us in grass, if we will but read it: we know that "all flesh is as grass." The alphabet in which the story is told, in reality, is one of remarkable simplicity and that so few care to make the attempt to master our shorthand, the language in which our story of flowers is told, is surprising, to say the least. The outward beauty of the flower is patent to every one—the inward beauty of its mechanism, to the seeing eve, is marvellous beyond compare—the man who has done so much to interpret its character may well be deemed worthy among us.

Richard Willstätter was born in Carlsruhe (Baden) on Aug. 13, 1872. At first, he was educated there but afterwards, on removal of his parents to Nürnberg, at the Realgymnasium of that town. When eighteen years old, he entered the University of Munich, where he began the study of chemistry under the great Adolf von

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Bacyer, a master of laboratory eraft, known to the world as the first to prepare indigotin artificially, the colouring matter of the indigo plant. The fifteen years of his career were spent there as student and privat-docent, and finally, from 1902 onwards, as extraordinary professor and head of the organic chemical department. In the spring of 1902, he was appointed full professor (ordinarius) at the noted Zürich Technical High School. After spending seven years in Zürich, in 1912 he returned to Germany to take charge of the Chemical Research Department established by the Kaiser Wilhelm Society at Dahlem, Berlin. It was here that he carried out most of his work on plant-colouring matters. Ultimately, he be came professor at Munich, in succession to Adolf von Baeyer. He was elected a member of the Prussian Royal Academy of Sciences in 1915 and received the Nobel Prize in 1920.

It appears to have been Willstatter's ambition, from an early stage in his career, to undertake the study of vegetable and animal pigments and he advisedly entered upon a considered course of original study to acquire the necessary technical proficiency in preparation for this task. Beginning with the vegetable alkaloids, atropine and cocaine, which he was able to prepare artificially, he passed to the study of the quinones, a class of compound to which at least a majority of dyestuffs belong. He made a notable addition to knowledge by his discovery of orthobenzoquinone. He then entered upon his great inquiry into the nature of chlorophyll. He next devoted himself to the study of the red and blue colouring matters of flower: Of late years he has been engaged in the attempt to isolate enzymes. These, however, are only the main lines of inquiry which have occupied his attention. A German professor, especially if he be a man of established repute, is called upon to provide subjects for a large body of young workers. hence it comes that Willstätter has touched a great variety of themes other than those referred to above. He has thus been led to solve a number of problems of special interest and more than ordinary difficulty. Among the inquiries, that on hydrogenation under the influence of platinum may be referred to as one of prime importance.

The studies of the green colouring matter of plants are described in twenty-four memoirs, published in Liebig's Annalen der Chemie during the years 1906-14, and in a book written in conjunction with A. Stoll (Berlin, 1913). It will be remembered of Shibili Bagara that he "pre-

<sup>&</sup>lt;sup>1</sup> F. Pollock in Leslie Stephen and Frederick Pollock's Lectures and Essays, by W. K. Clifford.

pared a rapid lather and dashed it over Shagnat and commenced shaving him with lightning sweeps of the blade (Aklis). 'Twas as a racing wheel of fire to see him." So Willstatter with chlorophyll. When he began the inquiry, the view prevailed that chlorophyll was but a group name and even that each plant might contain its specific chlorophyll. Not the least remarkable outcome of his work has been to show that, in more than two hundred species of Cryptogamic and Phanerogamic plants, the same mixture is to be found, in slightly different proportions, of two closely related compounds, which he has termed  $\alpha$ -chlorophyll and  $\beta$ -chlorophyll, the former being blue-green, the latter yellow-green This result is surprising in view of the fact that no two animals contain the same hæmoglobin, although one hæmatın is common to all, the globin (protein) component varying from species to species Willstatter has further shown that, in the cell plastid, as indeed Sir G G Stokes first pointed out in 1864, the two chlorophylls are associated with two 'yellow' colouring matters, one the well-known hydrocarbon carotene, C40H56, the other a previously unisolated compound, xanthophyll, C<sub>40</sub>H<sub>56</sub>O<sub>2</sub>, apparently a derivative of carotene The Phæophyceæ alone also contain a third carotinoid, fucoxanthin, C40H56O6

The method of separating the chlorophyll compounds adopted by Willstatter is that originally proposed by Stokes and involves the use of more or less immiscible solvents, particularly petroleum spirit and aqueous alcohol. Being soluble in a mixture of petrol and alcohol but insoluble in petrol,  $\alpha$ - and  $\beta$ -chlorophyll are precipitated when the alcohol is washed out of the solution. The method is one by means of which the pigments may be extracted from either dry or fresh leaves as easily as may an alkaloid or a sugar. The two chlorophylls are separated by fractional crystallisation from methylic alcohol and petrol. They are usually present in the proportion of about three molecules of the a- to one of the  $\beta$ -compound. Their composition is remarkable, that of the a-compound being represented by the formula

### $C_{32}H_{30}ON_4Mg(CO_2CH_3)(CO_2C_{20}H_{39}).$

The  $\beta$ -compound differs only in containing an additional atom of oxygen. It will be seen that they are dicarboxylic derivatives. Significant constituents are magnesium and the radicle  $C_{20}H_{39}$  of the complex alcohol, *phytol*,  $C_{20}H_{39}$ . OH, about one-third of the weight of the molecule consisting of this component. The condition of the magnesium

is peculiar, as the metal is not displaced by the action of alkalies, though readily by that of acids. Its behaviour, therefore, is similar to that of the iron in hæmoglobin. The carboxyl-free mother substance of  $\alpha$ -chlorophyll is a complex pyrrole derivative ( $\alpha$ -chlorophyrin) and the magnesium is probably associated with the nitrogen in this complex. This derivative is represented provisionally by the formula

Ætioporphyrin is a compound of outstanding interest as it is also obtainable from hæmoglobin. It is noteworthy that Fischer and Klarer have recently prepared a compound synthetically from 2:4-dimethyl-3-ethylpyrrole which appears to have the properties of Willstatter's product. That primary functions of life should be exercised, both in the plant and in the animal, by compounds of similar parentage is more than remarkable function of hæmoglobin, apparently, is that of a mere oxygen carrier—it is little more than a gasholder. Chlorophyll plays a far more complex part, as it in some ways promotes the absorption of solar energy that is involved in the reduction of carbonic acid to formaldehydrol, CH<sub>2</sub>(OH)<sub>2</sub>, and the concurrent elimination of oxygen, in the primary process of assimilation.

Willstatter and his co-workers have shown that the chlorophylls remain unaltered in amount throughout the process and that they can enter into loose conjunction with carbonic acid: possibly the connexion is established through the magnesium and the carbonic acid thus made part of the energy-absorbing system. Once formaldehydrol is produced, passage to the sugars is a simple matter: yet this must be a directed operation, as the aldehydrol gives rise to only one of the two optically opposite forms of hexose. Those who talk glibly of the artificial imitation of the life process forget these little peculiarities and limitations—and so mislead the public into unjustifiable

beliefs. Whatever the process, there is no reason to believe that earbonic acid is more than half reduced and the oxygen that is liberated is probably not derived from the earbon dioxide but is formed by the electrolysis of water. The operations are carried on within the chlorophyll plastid in presence of carotene and xanthophyll, both highly oxidisable substances; it is surprising that oxygen should be liberated within such a system and be without effect upon it, the more as various oxidisable materials are formed within the plastid. Elsewhere, I have ventured to suggest, that the yellows serve to inhibit oxidation and thus exercise a protecting effect upon the system an effect such as Moureu and Dufraisse have shown to be often produced by the 'interference' of substances which are oxidisable separately but in admixture, apparently, are unaffected by oxygen.

The statement is made in Sir Frederick Keeble's recent work on "The Life of Plants" that

"The wheat plant alone, producing as it does a world crop containing some 70 million tons of carbohydrate, 'handles' each year about 114 million tons of carbon dioxide and liberates to the atmosphere over 80 million tons of oxygen. The energy-value to the plant of the carbohydrate produced during photosynthesis may be computed on the basis of the amount of heat found by experiment to be liberated when a given amount of starch is caused to undergo combustion. The combustion of one ounce of starch liberates 116 calories and it is, therefore, only a matter of calculation to discover the energy value in terms of calories of the carbohydrates of the world's wheat-crop. The heat which would be produced by the combustion of the 70 million tons of carbohydrate would suffice to raise to boilingpoint all the water of an ice-cold lake four miles long, four broad and of an average depth of forty fathoms."

As all plants, through their leaves, exercise a similar activity, chlorophyll does some work in the world—we, therefore, might well learn to look upon it with respect, even take some little interest in its character and functions.

Of what value, however, is colour in the flower? Who shall say what the significance of colour may be? We are most of us alive to its æsthetic charm and value—what of insects: are they? If attracted by it and the fertilisation process be in large measure an outcome of such attraction, then indeed it is of utmost consequence to life.

The patterns of the colours in flowers have been deciphered with surprising skill and surprising swiftness by Willstätter and he has shown, more-

over, that they are of remarkable simplicity. He has dealt with the reds and blues, which he has termed anthocyans, the yellows have been fairly well studied by others. In many plants, yellow and orange are due to xanthophyll and carotene: in other cases, they are mostly traceable to the presence of hydroxy-derivatives of flavone, present as a white meal upon the leaves and flower stalks of many of the Primulaceae. Flavone, as shown by Hugo Müller, may be resolved into acetophenone and salicylic acid—two simple substances.

The anthocyans are mostly glucosides, yielding on hydrolysis either glucose or galactose or rhamnose together with the coloured component or anthocyanidin, which in some cases is a methylated derivative. They are resolved by the action of alkali into the trihydroxybenzene, phloroglucinol, either parahydroxybenzoic, protocatechuic acid or gallic acid or maybe a methylated derivative of one of these. The parent substance may be formulated as an orthoguinonoid derivative,

In many respects their properties are peculiar but it is impossible to discuss them here. The reds are but acid forms of the blues. As in the flavones, the intensity of the colour increases with the number of hydroxy groups in the lateral phenyl group. Much might be said on the relation of colour to structure in these compounds were space available—no more fascinating subject could be entered upon.

Willstätter's work has of course been followed by a synthetic repercussion. In recent years, Prof. Robinson, in Manchester, has most skilfully developed methods with the aid of which it is possible to prepare anthocyanidins in the laboratory in any desired quantity: so to-day we can paint the lily with its own pigments.

Passing now to Willstätter's most recent work, that on enzymes, we are brought into a troubled field, one which, however, we must contemplate

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with wonder, as their activities lie behind the mysteries of life.

\*The colouring matters of plants appear to be without functional significance—they seem to be mere dress effects. Chlorophyll, however, is life at its outset, as by its agency the bricks are shapen which Nature hands to the plant: not only so, for with its aid energy is captured from the sun, which the plant not only uses to its own ends but also passes on to us. What of the enzymes, Willstätter's latest subject of study? Life, we know, in the main involves only two processeson one hand, that of hydrolysis and its reverse; on the other, that of oxidation (hydroxylation) and its reverse. Oxidation, apparently, is determined and controlled by agents which are limited in their range of action but not specifically selective and, therefore, are not to be counted with the enzymes. The enzymes are the agents in charge of the hydrolytic process, whether this be downgrade or upgrade. They apparently are the templates which regulate constructive metabolism, both in plants and animals, for they are strictly selective agents. Hitherto they have been elusive entities, only characterised by their effects Willstatter's efforts have been to prepare them in the individual state, so that they may be further characterised and their nature determined. The task is one of extraordinary difficulty. He has shown that they may be handled with far greater impunity than had been supposed and has devised methods of purifying them whereby he has greatly raised their activity but without arriving at any definite result. The final picture he has drawn for us of the enzyme is that of a colloid carrier of a group which is the active component: a picture drawn by my son and myself in 1913; indeed, we went further, in showing the colloid in attachment with a directing group, in addition.

I perhaps more than any one can appreciate the value of work so varied yet always in logical connexion—can wonder at the genius displayed and the self-sacrificing devotion of the worker to his task. Only the few among us can be aware what such inquiry means, what it involves -what are its joys-what its pains. Perhaps, some day, these matters will come home, in some slight measure, to those who in the arrogance of their ignorance pretend to rule the world-I say this because I should like to think that "the flag of my disposition [is] out of hopeful green stuff woven" and that the moral value of inquiries such as have been referred to may not always remain unknown HENRY E. ARMSTRONG. to the public.

Corrosion-Some Causes and Remedies.

The Corrosion of Metals. By Ulick R Evans. Second edition. Pp. xv1 + 259. (London: Edward Arnold and Co, 1926) 15s net

TWO years ago (May 23, 1925, p 793) the first edition of Mr. Evans's book was reviewed by the present writer in the columns of NATURE. Its good qualities have evidently been widely recognised, since a second edition has recently been published. The author states in his preface to this that progress made during this period in the understanding of the processes of corrosion has made so many additions necessary, that it has taken him longer to write the second edition than the first. The same general arrangement has been preserved, and he has adhered to the policy of giving a concise statement of the subject in the text accompanied by numerous references in the foot-notes to papers where further details can be sought on any particular point of interest. The net result is the production of a book some forty pages longer than the original volume and the published price has been slightly increased.

We learn from the chapter on the corrosion of copper and copper alloys, that an interesting protection process has recently been adopted by the Cunard Steamship Company, Ltd, which consists in spraying the interior of the condenser tubes with a bituminous composition. Austin, who has described the process in detail (Trans. Liverpool Eng. Soc., 46, 1925), states that the vacuum is reduced by ½ to ½ inch (owing to the decrease in the thermal conductivity of the coated tubes) but the over-all efficiency is not affected. Mr. Evans suggests as the reason for this, the increased cleanliness of the boiler heating surfaces and turbine blades. So far the experiment has proved very successful, only 21 tubes out of 28,500 having failed since its installation. As yet the process has not been tested in ships sailing in warm waters. The electrochemical process for protecting condenser tubes is stated to be somewhat of a disappointment, and the latest reports from many trustworthy sources indicate that in many cases little or no benefit has been obtained where it had been installed. Dr. Honegger states that in some cases the process has failed completely, while in other cases it has proved very useful It seems quite possible that in the latter cases this has been achieved by the deposition on the tubes of a film of 1ron compounds derived from the anode rather than by true cathodic protection. Bengough and Stuart have pointed out that the weak feature of the method lies in the impossibility of securing the distribution of the current over the whole of the tube surface. Mr Evans directs attention in a foot-note to the fact that there is no fundamental reason why cathodic treatment should put a stop to corrosion and that cases are known where mild cathodic polarisation—by keeping the metal active—may actually accelerate attack.

In Chapter xi, entitled "Protection against Corrosion," we notice the statement that "the employment of sodium silicate (water glass) as an inhibitor is increasing." It finds application as an addition to plumbo-solvent waters prior to their entry into lead pipes. It is used in cleaning alumin-1um Both in liquid and solid form it is also being used to prevent the destruction of iron pipes by water and, in many cases, has been found to reduce corrosion considerably In recent years the same material has been used in increasing quantities in boilers. Here, however, other questions are raised, e.g. the possible effect of the protective film (which is probably silica or a silicate) on the heat-transfer, the possible increase of foaming and the action on Further research on all these the brass fittings points would be of value Hall, who has made a long study of boiler scales, points out that a calcium silicate scale has a most pernicious effect in a boiler. It is therefore not advisable to add sodium silicate to a hard water rich in calcium.

It is interesting to notice the author's statement that the electro-deposition of chromium as a protective coating is now being utilised. This metal does not adhere well to steel if deposited directly, but satisfactory results have been obtained if a thin layer of copper or nickel is first deposited on it. The chromium plating then follows, usually from a bath containing chromic acid and chromium sulphate, which must be kept cool. It is stated that plated articles manufactured in this way withstand corrosion by sea water, and also exhibit resistance to tarnishing The hardness of chromium is a considerable additional advantage. It may be that this metal will prove a serious rival to nickel in spite of the greater expense involved. Later on in the same chapter we observe a reference to the operation known in Germany as Nitrierung, which consists in protecting iron by heating it in ammonia, a process which produces a very hard nitride layer. Actually this process is mainly applied for increasing hardness, but it does afford some protection against corrosion.

Several processes have been worked out for producing protective coats upon metals by subjecting them to anodic treatment in suitable solutions.

Special reference should be made to the work of Bengough and Stuart, who have devised a method for the protection of aluminium and its light alloys such as duralumin which has given most promising results. The articles in question are made the anodes m a 3 per cent solution of chromic acid at about 40° C. The cathode consists of carbon. The applied E.M F is gradually raised to a value depending on the nature of the alloy and the composition of the bath. After treating for some time in this manner the surface of the metal becomes covered with a semi-opaque uniform white This seems to consist almost entirely of aluminium hydroxide in a glassy adherent form. Possibly it is hydrated to some extent, but the amount of hydration cannot be large, since the coating can be heated to 350° C, without changing in appearance or density. Not only does this coating afford considerable resistance to corrosion, but it also acts as an excellent basis for the application of protective paints or varnishes which are not very satisfactory if applied to untreated aluminium. The anodic protection of duralumin is finding wide application both in the aircraft industry and in the protection of artificial limbs against corrosion

The final chapter on corrosion-resisting materials contains the latest information on the many varieties of stainless steel and stainless iron now available. The alloy manufactured in England under the name of 'Staybrite' contains no less than 18 per cent, chromium and 8 per cent, of nickel; the German material known as V2A contains from 20 to 25 per cent of chromium and 6 per cent. of nickel. Unlike ordinary stainless steel, which has a duplex structure, these alloys, as Mr. Evans points out, consist of a single phase The iron is in the austenite (gamma iron) condition. Accordingly the materials are ductile and can be wrought into almost any form. It has even been found possible to weld them. Reference may also be made to stellite, which is the most important corrosion-resisting alloy of cobalt. It is a very composite alloy containing considerable quantities of cobalt, chromium, and tungsten, and smaller quantities of iron, carbon, and possibly silicon and manganese. It combines good anti-corrosion properties with great mechanical hardness.

In conclusion, it may be stated that the second edition of Mr. Evans's book is even more serviceable than the original volume, and the demand for it will probably be at least as great. We hope it will be even greater.

### A Projected Art of Light.

Colour-Music: the Art of Light By Adrian Bernard Klein. Pp. xvi + 287 + 24 plates (London. Crosby Lockwood and Son, 1926.) 36s net.

THE project of an art of light, analogous to music, threatens to become an obsession, recurring in every generation, attacking indiscriminately philosopher, artist, and empirical scientist. It is particularly insidious because it cannot be flatly dismissed as a mere chimera. There may be something in it, and there is no alternative but to think the matter out.

Other than Major Klein probably no one has combined so firm a belief in the possibility of this art with so comprehensive a group of the relevant scientific data, or with so frank a recognition of the difficulties in the way. His work will certainly rank for a long time as the standard authority on the subject, and it leaves no excuse for future exponents ignoring their predecessors' errors enormous amount has gone to its compilation Approaching the question from an historical point of view, the author has studied every important contribution, examined every instrument, and canvassed every opinion. (The bibliography ranges from Aristotle to the provincial press reports on the touring colour organ.) Not every opinion is equally important, and the author would not have been blamed if he had dealt more fully with some of the central issues at the expense of some But even in the of this historical material bewildering byways of speculation he himself is critical and alert.

Theoretically, the abstract possibility of an art of light is reasonably established. Colours presented in succession can produce a definite esthetic effect. But this is obviously not enough. Pyrotechny is a sort of art of light; but what is projected is something more profound, something really comparable to music. This is a further and more difficult issue, raising a host of technical, practical, and esthetic questions

Scientific interests enter in two ways. First, adequate theoretical foundations must be secured. The physical properties of the spectrum provide a tangible starting-point, but the scales of colour must apply to every dimension of the colour octahedron (or whatever schema is ultimately adopted) and must be empirically determined with due regard to the individual variations of differential threshold, and for all the facts of colour sensitivity arising from the peculiarities of the cerebro-retinal mechanism. A technique for estab-

lishing such scales is, of course, at hand in Fechner's psycho-physical methods, but scales so established would not imply 'intervals' of the type required. On this crucial point the whole inquiry has been given an unfortunate twist by two curious phenomena which, in virtue of their peculiarity rather than their importance, have impressed the imagination of most inventors of an art of light. One of these is the psychological curiosity of synæsthesia, the other is the, after all, surprising fact that harmonious 'intervals' experienced in awareness of tones are physically paralleled by certain simple ratios between the frequencies of the vibratory stimuli. The combined effect of these two facts has been to foster a number of fruitless attempts to accompany music by synæsthetic lights or even to translate music directly into colour, and to encourage a great deal of specious but wholly unconvincing argument to establish harmonic colour scales on the basis of the ratios of the frequencies of waves of light.

It is one of the solid merits of Major Klein's work that he refuses to be ensuared in this inversion of the natural and logical order of investigation. After a careful analysis of these theories he comes unambiguously to the conclusion that the intervals of colour must be independently established. Independently established, but how? The author, it seems, is not enamoured with the method of paired comparisons, preferring to await the birth of a colour musician who will divine the laws of colour harmony by the unaided light of Nature. That would be eminently desirable, but the point is, we rather urgently require some preliminary evidence that the laws are there for him to divine. What we know at present with regard to the harmony of co-presented colours cannot (owing to the factor of spatial configuration) be applied simpliciter to colour sequences The fact that no adequate research has been directed upon the problem of colour 'melody' constitutes a serious weakness in the theoretical foundations of this art.

A second strain of purely scientific interest enters in connexion with the provision of technical devices for the control of colour stimuli. For good, though not conclusive, reasons, Major Klein has committed himself to a policy which will engender serious practical obstacles to the cultivation and diffusion of the projected art. He requires a specially constructed hall and an elaborate type of projecting spectroscope controlled by a keyboard embodying the principles of the theoretical colour scales. Now, the art of sound has had the advantage that the human organism is itself a musical

instrument and potent instinctive tendencies have motivated its use and exercise. Per contra, the art of light lacks this natural basis—and simple instruments fail to achieve any very impressive effects. But even a tom-tom or a simple pipe can produce a distinct effect, and without them we should have had neither orchestra, composer, nor audience. Inventions of the art of light have pursued many analogies, but not the biological. What is the counterpart in colour music to the folk-song or the country dance? When his instrument is to cost £10,000, how is the colour musician to acquire facility in his art? Perhaps the failure of simple instruments points to a certain weakness in our reactions to mobile colour. The emotional possibilities may be too limited to support a vital art, and some centuries of further cultivation may be required. Perhaps, too, the author has unwittingly aggravated his difficulties by applying to a new and infantile art æsthetic theories derived from modern and sophisticated spheres. But on æsthetic theories each man may hold his own opinion, and these at any rate fall outside the scope of the present review.

The objections are not final. To prophesy a negative is as difficult as to prove one; and a new approach may completely change the situation. In any event the author has performed a useful service in presenting the problem in a clear and definite way.

C. A. MACE.

### Recent Literature on Enzymes.

- Die Fermente und ihre Wirkungen. Von Prof. Dr. Carl Oppenheimer. Nebst einem Sonderkapitel: Physikalische Chemie und Kinetik, von Dr. Richard Kuhn. Fünfte, völlig neu bearbeitete Auflage. Lieferung 9. Pp. 1205-1392. 17.40 gold marks. Lieferung 10. Pp. 1393-1568. 17.10 gold marks. Lieferung 11. Pp. 1569-1744. 17.10 gold marks Lieferung 12. Pp. 1745-1871. 17.45 gold marks. Lieferung 13. Pp. xvi+1873-2037. 19 gold marks.
- (2) Lehrbuch der Enzyme: Chemie, physikalische Chemie und Biologie. Von Prof. Dr. Carl Oppenheimer. Unter Mitarbeit von Prof. Dr. Richard Kuhn. Pp. ix + 660. 33 gold marks. (Leipzig: Georg Thieme, 1927.)
- (1) WE have already dealt with Parts 1-8 of this work, and now that it has reached completion with Part 13, including an author and subject-matter index, it seems desirable to review the entire work.

The first edition of "Die Fermente" appeared No. 3009, Vol. 1207

as quite a modest volume twenty-five years ago, and since that time the immense amount of work which has been carried out on the subject of enzymes has necessitated the publication of several fresh editions, the task culminating in the compilation of the present extensive treatise, dealing in an exhaustive manner with what is now one of the most important branches of biochemistry. The last edition of Prof. Oppenheimer's book has been out-of-print since 1918, and it was decided by the author to recast the whole work, retaining only here and there those portions of the previous text, without altering its general plan. In view of the large additions to our knowledge during the past decade, it has been found necessary to omit some of the older observations, which in the opinion of the author are obsolete. In adopting this course he points out, however, that he has paid due regard to the necessity of preserving the character of the work as giving a complete account of the subject.

We know very little at the present time concerning the chemical nature of an enzyme, but as a result of the most recent work, among which that of Willstatter stands out prominently, enzyme preparations have been purified and their activity thereby increased enormously, whilst at the same time some of them have given indications that they consist of chemical entities. But in all probability an enzyme will be found to constitute a system rather than a single chemical substance. In this connexion, however, attention may be directed to the recent work of Sumner (1926), who shows that a crystalline globulin from jack bean exhibits the activity of a urease. He states that it may be recrystallised by solution in water and addition of acetone up to 30 per cent. concentration and gradual treatment of the solution at 0" with potassium dihydrogen phosphate of pH 6·1. Here, however, we have the presence of the phosphate to be taken into account, which probably does something more than adjust the hydrogen ion concentration. What may be called the nucleal part of this system is the zymogen, which under certain conditions is rendered active. The chief of these conditions is the hydrogen ion concentration and the presence of certain electrolytes. Machaelis regards enzymes as amphoteric electrolytes or ampholytes; and this theory, developed by Bjerrum, is dealt with fully in the treatise.

The entire work is spread over 2037 pages and is divided into two volumes. The first volume, covering 775 pages of text, deals with the general chemistry of enzymes, the kinetics of their actions and the biology of the subjects, the concluding

part of the volume being devoted to the esterases (lipase, etc.), the carbohydrases, and the nucleases. The second volume is concerned with amidases, aminoacidases, proteases, and a group of enzymes connected with oxidations and reductions, to which the author has given the name desmolases, including zymase, the various oxidases and autoxidisable substances such as glutathione.

The author classifies enzymes according to the substrata on which they act thus esterases, including the lipases, carbohydrases, proteases, and desmolases, including zymases and the respiratory enzymes. He admits that if in the future some knowledge be forthcoming of the constitution of a given enzyme, a fresh classification will have to be elaborated In this connexion we may quote his remarks: "It can only be hoped that the work on the chemical nature of the ferments which Willstatter has so happily inaugurated, will lead to clear and definite results. If the structure of one of the ferments is cleared up, this will soon be extended to the whole class, just as with the hormones as exemplified in the case of adrenaline," and he might have added thryoxin, which, however, has been synthesised by Harington since the publication of this treatise.

Under physical chemistry and kinetics, ultrafiltration, kataphoresis, complexes with heavy metals, surface tension and adsorption phenomena, and reciprocal precipitation of colloids are discussed. Reaction velocity and catalysis are fully dealt with. Discussing the thermochemistry of fermentation, it is shown that the theoretical quantity of heat envolved per gram molecule of glucose fermented is  $28 \cdot 2 \, K$ , whereas Rübner found experimentally  $24 \, K$ . No reference is made, however, to the determination of the heat of fermentation of maltose by the late A. J. Brown, whose results were derived from practical data in a brewery.

The interesting observation of Kuhn (1923) is recorded that the invertase (sucrase) from yeast (bottom fermentation) and from Aspergillus oryzæ respectively behave differently towards sucrose. In the former case the hydrolysis is slackened by the presence of d-fructose, whilst in the latter case it is slackened by the presence of d-glucose.

That a treatise of so comprehensive a character as that before us was much needed, no one will deny, but much as we value it we are bound to say that the text is needlessly diffuse and abounds with repetitions. The lipase of seeds is said to be distinguished from that present in the liver and tissues of animals in being insoluble in all solvents,

and this statement is repeated several times. Many other similar cases could be cited. We are surprised to find the statement that, during germination, amylase is rendered soluble without altering its functions. Amylase of raw grain (barley) is probably partially insoluble, and the maltase which accompanies it is insoluble, but amylase of germinated grain will act on amylopectin, whereas that of raw grain merely depolymerises it.

The best way to judge a book of the kind before us, however, is to use it, and it gives the present writer pleasure to state that he has found the treatise invaluable as a book of reference on which to base his lectures on enzymes and to serve as a guide to original papers on the subject.

(2) The authors have prepared this work from the larger treatise "Die Fermente," of which it is a shortened edition, to serve as a students' manual. That such a manual was needed there can be no However, the text of the larger treatise has been to a great extent retained, the difference being that whole parts have been excised and that fewer references are given to the literature. The names of those responsible for the observations cited in the text are given in some cases without references. In our opinion it would have been much better if the work had been entirely re-cast, as it would then have been possible to reduce the size of the volume considerably and to obtain a better logical sequence in the text, which is specially desirable in a book intended for students. The subject matters are arranged in the same order as in the larger treatise, but many pieces of work which have appeared since the publication of the earlier parts of the latter are referred to, thus bringing the book up-to-date.

ARTHUR R. LING.

### Our Bookshelf.

The Reproduction of Life: a Handbook of the Science of Reproduction in Nature and Man. By A. J. Cokkinis. Pp. xvi+287. (London: Baillière, Tindall and Cox, 1926.) 10s. 6d. net.

THE author states in his preface to this book that his aim in writing it has been to fill the need of a simple, yet accurate, scientific account, intelligible to the adolescent boy or girl, of the phenomena of the reproduction of life. The problem of selection and presentation of material for a book of this kind is a difficult one, as any one who has had experience of teaching hygiene to school children will appreciate, and Mr. Cokkinis has not been very successful in solving it. He has attempted to cover an unnecessarily wide field. Those sections on plant and animal reproduction, in which he describes and figures, often inaccurately (see, for

example, Figs. 59 and 69), the reproductive organs in plants, and in the more important classes of the animal kingdom, can be studied in any elementary text-book of biology, with this advantage, that they are there set forth with correctness of detail. A short account of the cellular basis of living organisms, with a clear description of the differences between asexual and sexual reproduction, oviparous and viviparous development, would have been sufficient introduction to the study of the question in man. The great difficulty which the average individual naturally experiences in visualising, with any clearness, the position and relation of the organs of the body, makes it absolutely essential that these points should be illustrated by careful, large-scale drawings. Isolated diagrams of partially dissected systems, such as are given in this book, convey nothing to the untrained mind. H. E. B.

The Principles of Petrology: an Introduction to the Science of Rocks By Dr. (\$\frac{1}{2}\$. W Tyrrell. (London. Methuen and Co., Ltd., 1926). 10s. net.

This is the first of a geological series of books to be published under the general editorship of Prof. J W. Gregory. Two others are promised. After reading the book one feels that the author could himself have contributed three separate books on petrology. In this small volume, igneous, sedimentary, and metamorphic rocks are all dealt with, and the space is quite inadequate to the subject. The author is very widely read, as his numerous and excellent abstracts published in Science Progress prove, and he has endeavoured to include in his book every recent contribution to the science of petrology. It is indeed, to quote the author's preface, "a conspectus of the present state of the science of petrology," but it is a little doubtful whether the workers in other branches of geology or "students who have acquired an elementary knowledge of the science" will know quite how much to believe when they have read it all.

The descriptive parts of the book are very clear. Metamorphic rocks are dealt with in seven chapters describing the various processes and their products. Only six chapters can be devoted to "Secondary" rocks, classified as residual, sedimentary, and chemical. Good chapters under Part I (Igneous Rocks) describe forms and structures, and textures and microstructures. The author develops some of his own ideas on classification, and has some very interesting remarks on distribution in space and time. The suggestion to use the terms 'kindreds,' 'tribes,' and 'clans' for groups or series of rocks showing different degrees of close relationship may be useful if every one uses the terms in the same sense.

Soviet Union Year-Book, 1927. Compiled and edited by A. A. Santalov and Dr. Louis Segal. Pp. xxiii +453. (London: George Allen and Unwin, Ltd., 1927). 7s. 6d. net.

WITHIN reasonable compass this well-arranged volume gives a great deal of information about present conditions in Russian territories in Europe and Asia. The extensive bibliography of Russian works indicates that the facts and figures have been taken from the most recent official sources. No other than Russian publications find a place in the list. The agriculture, mineral resources, and trade of the Soviet Union are treated in great detail. The regulations for foreign trade are given, and particular attention is paid to the trade with Great Britain. Another section explains the policy and gives the regulations for concessions and the attraction of foreign capital to Russia. Many pages are devoted to the political organisation and the constitution of the Soviet Union, the regulations for labour, the organisation of finances, and the principal clauses of the civil code. In fact, the volume is an authoritative treatise on the country and as such is of considerable interest mainly a statement of fact, and very few expressions of opinions have crept in. There are two coloured and two black-and-white maps. The present volume is the third annual issue.

Properties of Inorganic Substances—a Second Revision and Enlargement of Tables of Properties of over Fifteen Hundred Common Inorganic Substances. By Wilhelm Segerblom. Pp. 226. (New York: The Chemical Catalog Co., Inc., 1927.) 6 dollars.

ORIGINALLY published in 1909 and revised in 1916, these handy tables for the working bench have now been considerably enlarged by the inclusion of new descriptive matter and by the treatment of some hundreds of additional substances. The arrangement is convenient, the abbreviations are self-explanatory, the letterpress clear, and the paper serviceable. Not the least useful part of the book is the index, which includes the common names of the compounds referred to in the tables. With the exception of some forty pages devoted to non-metals and rare metals, the scope of the compilation is confined to the metals and acids commonly employed in the study of qualitative analytical chemistry.

A. A. E.

Pheasant Jungles. By William Beebe. Pp. xiii + 248 + 47 plates. (New York and London : G. P. Putnam's Sons, 1927.) 3 dollars.

MR. BEEBE, who is Director of Tropical Research of the New York Zoological Society, travelled to Ceylon, India, Burma, the Malay States, and Borneo to search for rare pheasants and to study their habits. The results of his explorations have been published in technical papers. The present book deals with a few of his adventures, and is not a connected account of his travels. The reader receives an impression of a cheerful and intrepid explorer, who was undaunted by any dangers, difficulties, or hardships. His success was probably chiefly due to his sympathy with the wild tribes who live in the remote jungles that harbour the rarer pheasants. Without their help he could scarcely have reached his goal.

Mr. Beebe has generous praise for the few British who administer the remote jungle areas, and whose methods of handling the native races won his admiration.

### Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

## Barrier Reefs as a Sign of a Subsiding Coast Line.

In my letter on the recession of the Tahitian coral reefs published in Nature of April 23, proof is given of the original continuity of the present barrier reef from shore to ocean slope The absence of a lagoon from parts of the coasts of both Tahiti and Moorea should alone prove that barrier reefs can no longer be taken as an index of subsidence without independent proof from the adjacent land, and the completion of the proof that barriers may be formed from broad reefs of the finging type should be decisive. Further, I propose shortly to publish proof that in the adjacent but older island of Moorea there has been a tilting, resulting in subsidence of the south coast, which, though it took place during the growth of the reefs, has not made any difference to their form off that part of the island. The investigation of recf problems owes much to the numerous papers by Prof. Davis, which insist upon, and explain, the geological factors which it is essential to take into account. The biologist must, however, join in these researches, and it is much to be regretted that this side has been entirely neglected in Davis's work. One also misses any detailed local descriptions of the great series of reefs, old and new, which he has visited, that of Tahiti being the only one I have seen; this appears in French m Annales de Géographie, 1918 In this Prof. Davis gives reasons for believing that the island has undergone a large subsidence, with which conclusion, after much consideration given to the subject on the spot. I am quite unable to agree.

The evidences given are (1) the flats at the mouths of valleys, (2) certain bays on the south coast The former is inconclusive, the latter wrong in fact. The figure given of one of these valley flats, apparently the Reme Valley just west of Papeete, shows a practically sea-level flat penetrating far into the hills. In fact, the largest of these flats goes but a few hundred yards inland, and in no case is it level, all the streams having a rapid flow throughout their course also interesting to note that two of the largest flats are partially cut off from that outside the line of the old marine cliffs, by spurs projecting across the valley from one side. This is not shown in the figure given, but its presence very greatly reduces the extent of the flat which can be regarded as a drowned valley. evidence from these flats leaves the question open, unless corroboration can be found elsewhere. This is supposed to be found in (2) the bays of the south coast, which failing, we are justified in adopting the explanation of the formation of the flats which Davis mentions only to dismiss, namely, the wanderings of the streams from side to side of their valleys when they find their exits more or less blocked by beaches thrown

up by the waves, or by incipient coral reefs.

(2) There are no bays in Tahiti or the peninsula of Taiarapu I am surprised to see that Davis quotes 'Port Phaeton,' on the west side of the isthmus which joins the two volcanic cones, and certain much smaller which are connected with it. Now Port Phaeton is not a bay in the ordinary sense at all, being merely the space left between the two volcanoes which is closed at the east end by the isthmus, which is mainly formed by a long lava flow from the southern and smaller cone.

This space is further narrowed into a valley-like outline by the growth of reefs, and the alluvial flats which they support. It seems extraordinary that this origin of the bay should have been overlooked, since it is patent that there never was here a stream large enough to cut what would be the broadest valley in the islands.

The little bays which open out of Port Phaeton on either hand are very peculiar, but consideration of their formation requires more space than is at present possible. They are certainly not drowned valleys, nor ordinary stream valleys at all. Those not filled by alluvium or marsh are extremely shallow, while some of those on the south side of the 'Port' are merely patches of reef, covered with a foot or two of water, which were left when most of the surface was converted into land by banks, some of alluvium, others of coral debris

(3) Charts of the whole coast of these islands have been made with great detail and accuracy, and on a large scale, yet no scrutiny has revealed submarine evidence of submergence.

I also regret that Prot. Davis did not combine his geological observations with detailed examination of the reefs, and so discover how very partial, and even inaccurate, are the accounts given by his predecessors, whose views he discusses at length He personally examined the undersea banks within the reef, which is evidently what I term the submerged flat, but there are two important mistakes in his description. bank is not mainly composed of sand, which covers coral rock thinly and is often absent altogether, and, of the hundreds of the blocks of stone with which they are strewn and which I have examined, all are colonies of the coral Porites, more or less dead and often much decayed. They are not "arrachés au récif par les vagues de tempête." Though sometimes moved about, or thrown ashore where the barrier affords no protection, they all grew in this part of the lagoon, and they are never found on the outer slopes. There are no 'negro heads' on the actual edge of the reef anywhere, and I know of only four pieces of reef rock which have been tossed on to the surface from an overhanging edge. Porites colonies are common on shore reefs exposed to heavy surf, though judging from the slowness with which they blacken and decay, the addition of another to their number is a rare event.

The origin of the lagoon by the hollowing out of a once continuous reef is dealt with as follows the hypothesis of the formation of the lagoon by the progressive dissolution of a reef continuing to develop on its outer border is in contradiction with the luxuriant growth of corals inside the lagoon, where it forms little islands, and with the deposit observable in many places in the lagoon, of debris brought from the reef and volcanic materials of the island. growth, in most of the Tahitian lagoons, is greatly restricted. It is conspicuous near Papeete as the reef surfaces are covered in a remarkable way with corals, but there is practically none at all on the side of the reefs, and the long projecting shelves, which have been taken as evidence of rapid extension, are exactly the reverse. That the lagoons are slowly shoaling may be admitted pending proof; that they are becoming narrower is certainly untrue in many cases, doubtful in others.

Tahiti is not unique. Moorea differs in several ways but is a variation of the same type. Davis seems to have missed the cliffs of the northern part of this island, which are equally evident, and on the northwest are higher than the average of those of Tahiti. His criticism of Daly's theory of glacial control therefore fails in this case.

The four other islands visited are not described, and of their structure I can give no information. They are all older, and probably, as in Rarotonga, their cliffs have been disguised by subaerial denudation.

Much exploration remains to be done in this group, which I should consider myself fortunate to be able to attempt.

CYRIL CROSSLAND.

The Zoological Laboratory, Cambridge.

## The Variability of Long Diffraction Spacings in Paraffin Waxes.

So much interest is being manifested in the polymorphism of long chain compounds, particularly the fatty acids (Piper, Malkin, and Austin, J. Chem. Soc., 1926, 2310. de Boer, NATURE, 119, 50, 635; 1927. Thibaud, Compt. rend, 184, 24, 96, 1927. Muller, Proc. Roy. Soc., A, 114, 542; 1927), that it seems advisable to report the results of some X-ray experiments with ordinary commercial paraffin waxes. Only one mention of X-ray studies of these complex mixtures of many hydrocarbons has been made, that by Piper, Brown, and Dyment (J. Chem. Soc., 127, 2194; 1925), who found that the lines of the C28 hydrocarbon appeared alone for a paraffin wax although this fraction furnished only 16 per cent. of the mixture and other members as high as C32 were probably present.

In the present investigation samples were prepared from waxes melting at 135°, 130°, 125°, and 120° F. by solidifying on glass plates and photographing in an oscillating spectrograph with copper Ka rays. Solidification took place under identical conditions, since cooling from above the melting-points to just below occupied 30 minutes. Remarkably sharp lines for three orders only were obtained corresponding to single long spacings, besides the 'side spacing' lines. These were all measured with greatest care and checked against photometric curves. The results are

as follows:

Wax m p.	$d_1$	No. C Atoms indicated,		ide Spacings	d <sub>4</sub> .
135° F.	39·42 Å.U.	20	4·24 Å U.	3.73 Å.U.	2.56 Å.U.
130°	38 58	28 5	4·17	3.73	2.51
125°	35·22	26	4·44	3.88	2.44
120°	34 38	25	4·23	3.93	2.33

Particular care was taken in the measurement of the side spacings in order to discover any possible regularity in the slight variations running parallel with the change in the principal spacing. These were further studied with pinhole diagrams and molybdenum Ka radiation. There is apparently no such regularity.

Some experiments demonstrated that the rate of cooling of the liquid wax film was a determining factor in the spacings. The 135° wax was studied further in this respect with the following result:

Cooling		$d_1$ .	$d_2$ .	$d_2$ .	$d_4$ .
Instantaneous	:	36·64 Å.U.	4·12 Å.U.	3·82 Å.U.	2-58 Å.U.
2 mm .		37 84 *	4·16	3·82	2-60
10 mm		38 24	4·21	3·86	2-63
30 min .		39 42	4·24	3·73	2-56
60 min		40 20	4·13	3·82	2-60

It is evident that the longer the time given the molecules for orientation the greater the spacing for the same wax.

The presence of addition agents in small amounts

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also affects the spacings, when the solidification conditions are kept constant, as shown by the following results on  $135^\circ$  wax with cooling during 10 minutes:

			$d_1$ .
Wax alone			38·24 Å.U.
., -11 pe	r cent a-naphthyle	ımine	38:315
	r cent diphenyl or		39.75
	per cent indigo .		40 70
	r cent. lead oleate		37.5

It is interesting to note that the translucency of the films measured with a Martin polarising photometer varied directly with the spacings, a property of practical importance in the manufacture of transparent waxed paper. The single exception is the wax containing soap. Lead cleate itself has a spacing of 37 5 Å U., and when added to paraffin wax even in so small amount as 1 per cent, seems to impress its own spacing upon the layers. It is still a matter of astonishment, not only that the principal spacing of a paraffin wax may be varied within limits almost at will, but also that these mixtures of as many as eighteen hydrocarbons with widely differing molecular longths form equidistant parallel diffracting layers at all. The explanation of the variability of the long spacing for the same wax is complicated by the fact that under different conditions different molecular lengths in the mixture predominate and also varying tilts of the molecules to the diffracting layers are possible. GEORGE L. CLARK.

Massachusetts Institute of Technology, Cambridge, Mass., U.S.A., May 12.

### Biological Fact and Theory.

Ir may seem scarcely sporting to intervene in a discussion between two such masters of controversy as Dr. C. Walker and Prot. J. S. Huxley, but there is a danger that ordinary biologists, in watching the clever play of these two duellists, may overlook the fact that the Mendelian theory so skilfully wielded by both is really a powerful weapon for the attack of biological problems.

Dr. Walker recognises that in many cases "the usual mode of distribution of the chromosomes between dividing cells before " (and after ?) " fortilisation, provides a perfect mechanism for the distribu-tion of 'genes'..." He then proceeds to criticise the 'Neo-Mendelian' theory on account of some apparent exceptions to this method of distribution, but this appears to be a hypercritical attitude. Exceptions are said to prove rules, and this "distribution of the chromosomes" is present in most cases of fertilisation. The exceptions are extremely interesting, of course; they should be and are being investigated, but what is the explanation of the normal behaviour of chromosomes before and after fertilisation? Dr. Walker would not claim that these very peculiar processes of reduction and fertilisation are present morely to mislead investigators, but he seems to think that they appear to be a perfect mechanism for the distribution of the genes and yet are not really such.

The transmission of paternal characters by the spermatozoon is not denied by Dr. Walker, and if he doubts the transmission of these characters in some way through the chromatin material of male sperm cell, there is very little left in the sperm. That would appear to make the problem more difficult still, and unnecessarily so. Admittedly it is difficult to imagine the potentialities (or half of them) for the development of an animal as being contained in the microscopic spermatozoon, but the facts of heredity indicate that they actually are. Then is it much more difficult to

believe that these potentialities are arranged in some sort of order in the individual chromosomes, since we know that both the potentialities and the chromosomes are there? The work of Morgan and others tends to show that certain facts in heredity are most easily explained by adopting such a theory, and there is no inherent impossibility in it in most cases, only there are apparent exceptions or difficulties in some instances which certainly require explanation, but these need not be regarded as fatal to the whole theory.

Dr Walker objects to the expression 'law' instead of 'theory,' and there, of course, most would agree with him. Taught by past painful experiences most scientists to-day would refer to any attempted explanations of natural phenomena as 'theories,' not laws,' but by all means let us make use of these theories so long as they are useful

J. S. Dunkerly

### Penetration of Radio Waves.

SINGULARLY little seems to be known as to the extent to which radio (wireless) waves will penetrate mto the ground, and yet information on this very point has become quite desirable masmuch as there are now two or three geophysical methods of ore prospecting which definitely attempt to use radio waves for the detection of ore beneath the earth

Experiments by one of the present writers, and others, in a mile-long tunnel at Montreal have indicated clearly that 40-metre waves could not be detected, at either end, when only a few hundred feet within the tunnel Broadcasting waves (400 m.) appeared to do better and were detected, with the help of good amplification, throughout the tunnel under an overload of 700 teet of limestone and igneous rocks Longer waves (10,000 m.) were detected yet more readily. But it remained uncertain whether these waves came into the tunnel through the air, or along the rails and electric wires, or whether they came through the rock. The only sure thing is that the 40-metre waves did not ponetrate to the centre of the tunnel by any of these means. Experiments by the U.S. Bureau of Mines at a mine near Pittsburgh indicate similar results, for although initial experiments seemed to point to the passage of radio waves through rocks, yet further experience showed that rails or wires were acting as carriers.

Experiments with submerged submarines prove that radio waves will not pass more than about 50 or 60 feet into seawater, no matter what the wave-length. But the question of penetration into fresh water, damp rock, and dry rock remains uncertain. Moreover, in ore prospecting, distances are used immensely less than the wave-lengths employed, and it has been asked whether we have to contrast radiation and induction, a convenient distinction well brought out in Dellinger's paper ("Principles of Radio Transmission," Sei. Papers, Bureau of Standards, vol. 15, p. 441), although of course at a given point and instant there can be but one electric vector and one magnetic vector.

The real object of this letter is to express the hope that some wireless enthusiasts may have the opportunity of making experiments underground in cave, tunnel, or mme which is absolutely devoid of wires or other conductors, and where the windings from the entrance are sufficiently devious to preclude the passage of waves through air down to the receiving apparatus consisting of coil, amplifier, and receiver Accurate measures of signal intensity would only A. S. Ěve. be still more valuable.

D. A. KEYS.

Bureau of Mines, Washington, June 7.

### Metosis in a Triploid Tulip.

Bridges and Anderson (Genetics, 10, 418-441, 1925) have shown by genetic experiment that in Drosophila trisomic in respect of the X chromosome, the chromosomes concerned are in the two-strand stage at the time crossing over takes place, that any strand may cross over with any other strand and that "two strands which have crossed over with each other are as free to cross over with a strand from the third chromosome as with a strand from the original two chromosomes "

Synapsis in triploid Diosophila has not been figured. but the description of crossing over given above applies exactly to the mode of pairing of the chromatids in Fig. 1, which is a diagrammatic drawing of a pachytene trivalent chromosome in a triploid tulip. Fig. 2 is a commoner form of trivalent in the same variety, and indicates the probability of a diminution in crossing over towards the middle of the chromosome as compared with the diploid if crossing over is indeed

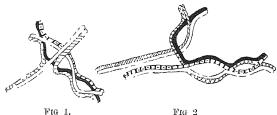


Fig 2

associated with pairing. A diminution from one end towards the middle region has been shown (Bridges

and Anderson, loc. cit).

It is not possible to suppose that this chiasmatypy or exchange of partners among the chromatids, whether in triploids or diploids, is a direct cause or consequence of genetic crossing over. The agreement between what is observed in the cells and what is required by the crossing-over hypothesis would, however, be explained if (1) pairing is a condition of crossing over, (2) pairing takes place between chromatids, not between whole chromosomes, and (3) chromatids remain together in pachytene and diakinesis for that portion of their length where they have been paired.

A full description of meiosis in various triploid tulips and hyacinths, together with a discussion of the

points raised, will be published later.

W. C. F. NEWTON. C. D. DARLINGTON.

John Innes Horticultural Institution, Merton, S.W.19.

#### The Hythe Skulls.

I FEAR Prof. Parsons (NATURE, June 18, p. 893) has not recently consulted his own paper.

Miss Hooke writes (Biometrika, vol. 18, p. 22). "The Hythe crama are in all probability those of Kentish men, dating back to the fourteenth and fifteenth centuries.

Prof. Parsons wrote in 1908 when publishing his memoir (Journal of the R. Anthropological Institute, vol. 38, p. 422): "It is probable that we are dealing with the remains of Kentish people most of whom lived in the fourteenth and fifteenth centuries."

Miss Hooke writes (loc cit): "Measurements were made on 590 cranıa selected from at least double that number "

Prof. Parsons wrote (loc. cit). "It may not be out of place to say here that the 590 skulls which have been measured consist of those which were picked out of the stack in 1851 and placed upon shelves, where they are now shown.'

The Oxford Dictionary's first equivalent for 'pick out' is 'select.' Miss Hooke neither directly nor indirectly suggests whether the selection was a 'random selection' or a 'biased selection.' not know what her views on that point may be. Personally, I think a series of crania extracted from a much larger heap for show on shelves is liable to "It was evident be biased. Prof. Parsons wrote from the debris that women's and children's skulls had, owing to their tragile nature, suffered more seriously than those of men, and this fact no doubt accounts largely for the excess of male over female skulls on the shelves" What Prof. Parsons wrote in 1908 would apply equally well to the more slender and lightly built crania of mon as well as of women. It is a sound rule of craniometry that all fragments should be pieced together where possible, and all broken crama should have their available measurements taken, otherwise the selection is far from a nandom sample, but consists of the thicker and very often the larger crania. The Hythe crania are worthy of careful study, but that study involves four or five years of continuous work, with the piecing together of fragments and a complete system of measurements on every available skull

THE EDITOR OF BIOMETRIKA.

### Surface Structures of Fractured Flints.

RECENT letters in NATURE by Reid Moir and W J. Lewis Abbott on surface structures of fractured flints prompt this note.

We had hoped to learn, by a study of the patina, the elapsed time since the original chipping was done. In some cases the patina seemed to be due to dehydration, but in any case it is caused by 'weathering,' and the depth of the patina depends on climate and time. The velocity coefficient of such reactions should be determinable, and an extrapolation for local conditions might give at least interesting results.

We found the first to be of so many varieties, when judged by surface changes due to heating, that no orderly report is possible. But a peculiarity in the case of English flints from Grime's Graves may be of interest. The surfaces of these old flints received from Mr. Reid Moir are nearly white (weathered). The interior is transparent to translucent and is scalbrown in colour. After heating at 600° C, for several days, a fresh-cut surface of this flint apparently remains unaltered, or takes on a clear, varnished appearance. A surface having the patina of ago retains it on heating, but discloses the transparent, varnish-like layer beneath.

The mass of the flint, except for these surface effects, is completely changed to a white, opaque material. In other words, high temperature in the case of this particular flint exactly reverses the apparent effect one might expect from weathering. The white patina of Nature is replaced by a transparent surface, and the inner mass appears 'weathered' or white. Can this be due to the rupturing forces of contained water? It does not occur in American so-called flints.

W. R. Whitney.

General Electric Company, Schenectady, New York, June 3.

## Smooth Electrodes for pH and Conductivity Measurements.

A COMPARATIVE study of different electrodes for the determination of the concentration of hydrogen ions has shown us that quite excellent results may be obtained with platinum electrodes covered electrolytically with gold and with a quite thm smooth metallic layer of platinum, iridium, rhodium, or palladium. A constant potential may be reached in a much shorter time than with the same metals in the form of a black deposit.

This led us to try the same electrodes for conductivity measurements. Electrodes coated with gold and metallic platinum proved to be much superior to electrodes coated with platinum black. Under conditions where with platinum black. Under conditions where with platinum black electrodes it was difficult to find the minimum of sound, with platinum-gold-metallic platinum electrodes the minimum (even m methyl-alcohol solutions) was extremely sharp. On the other hand, electrodes coated with gold and rhodium gave us unsatisfactory results. We are not quite sure yet about indium and palladium electrodes.

In this connexion it is interesting to note that a platinum foil coated with gold and metallic platinum acts catalytically on a mixture of hydrogen and oxygen, whereas iridium, rhodium, and palladium under the same conditions do not act catalytically or very feebly. We hope that a further study of these thin layers of metals of the platinum group will permit us to establish more clearly their catalytic properties.

University, Leningrad, June 11.

#### Florentium or Illinium?

My attention has been directed to the statement of Prof. Rolla in Nature for April 30, p. 637, in which he claims priority for the name florentium for element No 61. He says: "We believe, then, that the priority in the discovery of element No. 61 belongs instead to those who first had sure data as to its existence."

On this basis the name illinium deserves priority. The fact that Prof. Rolla deposited a plico suggellate instead of publishing his paper, demonstrates that he was not, at that time, sure of his discovery. When Harris, Hopkins, and Yntema published their paper and gave to element No. 61 the name illinium, they were sure of their results on the basis of four independent lines of evidence: (1) The 135 spectral lines referred to m NATURE (Feb. 26). (2) The concentration of illinium in rare earth fractions between needlymium and samarium. (3) An absorption spectral band characteristic of illinium. (4) The N-ray spectra.

W. A. NOYES.

Urbana, Ill., June 4.

### Specimens of Tropical Timbers.

It may perhaps interest some readers of NATURE who are concerned with the study of tropical timbers, to know that a certain number of duplicate timber speamens from the Burma type collection are available for distribution to museums or research institutions.

The specimen blocks, which are 6 m. 4 m. 2 in. in size, have been made from trees which have been individually identified botanically, with check identifications at the Forest Research Institute, Dehra Dun, and at Kew, the original sheets being in the forest herbaria at Maymyo and Dehra Dun or in certain cases at Kew.

No charge will be made for the specimens except for packing and freight.

A list of the species available can be obtained from the undersigned.

W. A. ROBERTSON. (Conservator of Forests.)

Utilization Circle, Burma, 46a Dalhousie Street, Rangoon, May 3.

No. 3009, Vol. 1201

## Irrigation and Crops.1

THE deleterious effect of irrigation on the soil, and therefore on the crops grown when it is not duly balanced by drainage, are described simply and clearly in an important memorandum drawn up by Dr. B A. Keen, of Rothamsted, for the Empire Marketing Board The memorandum is the work of an experienced soil physicist, and deals in summary form with the chemical and physical reasons for the accumulation of soluble salts on the surface of the ground, usually but somewhat erroneously described as 'alkalı.' Such concentration can, obviously, only take place where there is great evaporation of soil moisture, but little or no rain to wash the salts away, and the parts of the world where these conditions prevail are somewhat clearly defined. Taking the rainfall map as our guide, it can be seen at a glance that the amount of rain falling in the temperate and tropical regions is generally what may be called ample for crop production. But, round about and just outside the tropics of Cancer and Capricorn, belts of little rain or deserts are met with in the Old World, while in the New such tracts are confined more or less to the western sides of the continents These conditions are due, in the main, to the distribution of the ocean winds and currents. Clear skies are met with in these tracts, which in the local summer are connoted with intense heat and great evaporation of the soil moisture; whereas within the tropics the amount of cloud is much greater, the retarding force of the sun on vegetation is less, and a greater amount of rain falls.

Dr Keen points out that it has been estimated that one-third of the earth's surface receives 10 inches or less of rainfall in the year, while another third has under 20 inches; also, that at least 100 million acres of the world's crops, or 7 per cent., are under irrigation. This latter figure appears to us to be an extremely conservative figure, that is, if 'irrigation' has the usual meaning. For rice alone would probably account for a good deal more than the area named. In India the great bulk of this crop is irrigated, and there are 80 million acres of rice grown, while there are vast tracts in China and the East generally to be added.

It is, however, evident that it is the first-mentioned third that Dr. Keen has in mind while discussing alkali. He enumerates the factors concerned in the development of successful irrigation projects, and divides these into three main classes. economic, engineering, and scientific. The latter he rightly regards as fundamental, although the others may, in practice, easily become limiting; and classes them, roughly, as the composition of the water used for irrigation, and the chemical and physical properties of the soil, these factors being significant, both in schemes newly laid down and in old-established systems.

The chief part of the memorandum is devoted

<sup>1</sup> Irrigation in the Empire. Memorandum and Questionnaire. I Dr. B. A. Keen. (London: Empire Marketing Board, May 1927.) to the discussion of the importance of these scientific factors. Dr. Keen summarises and arranges, in an illuminating manner, the results obtained by the scientific workers on the spot, chiefly Russian and American, as to the causes of alkali and the scientific methods of fighting it The effect on alkalı land, when irrigation is commenced, is then elaborated in some detail. One important result is the chemical change induced in the constitution of the clay particles, that is, those which, though minute, are capable of aggregation into groups by what is called flocculation-which, indeed, is or should be the object of all cultural operations. Here the 'calcium clay' is in danger of being converted into 'sodium clay,' because of the large proportion of this latter element in the soluble surface salts now let loose This change renders flocculation in the soil difficult, and the soil becomes sticky and unworkable: and, if it is not checked in time, the presence of carbonic dioxide in the soil air induces a further and more dangerous change, namely, the formation of carbonate of soda, which is both toxic to vegetation and destructive of the physical character of the soil.

The tolerance of plants to alkali is briefly described. The crops mentioned are chiefly those of sub-tropical and warm temperate regions; and Dr. Keen quotes Russell, as giving maize the place of high sensitiveness to alkali, with barley and lucerne less so, while the date palm is mentioned as the least sensitive of all crops grown. The corresponding plants in warmer regions are given as sorghum, cotton, rice, and berseem: this correspondence cannot, of course, apply to the order of sensitiveness, which would probably be rice, cotton, berseem, and sorghum, the latter being among the most resistant cereals to alkali.

In a discussion of the dangers of deterioration in irrigated areas, attention is directed to the harmful effect of the change, from basin irrigation in the Nile Valley, with its beneficent summer fallow, or 'sheraqui,' to perennial irrigation, rendered possible by the larger supplies of summer water made available by the erection of the Assouan dam. It is pointed out that the gradual rise in the water table, lowering as it does the. root range of the crops, shows once for all the importance of adequate drainage being provided in all new irrigation schemes Attention is also directed to the tendency towards the application of excessive quantities of water to the crops, when this is left in the hands of the farmers, the example given being the interesting experiments conducted by the Howards on the growth of wheat in the Quetta valley.

Dr Keen concludes his paper with brief references to the importance of the study of the duty of water for each crop grown under irrigation, with especial reference to the quantity needed at each stage of growth the maintenance of tilth in irrigated land and its hindrances; and certain cases where alkali is not responsible for cultivation

difficulties. We presume that the troubles attendant on an undue proportion in alluvial lands of silt particles, that is, those too small to be flocculated, would come under this head. This is one of the main difficulties in many alluvial lands in the

tropics

Dr. Keen thus includes only a part, although an important part, because of the costly irrigation projects entered into, of the irrigated areas within the British Empire. This is probably because the Marketing Board has in view other discussions on the But the author has probably remaining portions purposely limited himself to the rain division mentioned above, and confined himself in India to the rainless Indus plain, thus leaving out the greater part of the Gangetic plain, where alkalı conditions have probably been the bugbear of agriculturists almost since prehistoric times. Leaving, then, these narrow limits, some further remarks may be made on alkali conditions found within the tropics, and then on some further lessons which may be learnt from irrigation generally in other lands in the tropics.

Alkali is of much less importance within the tropics, partly for the reasons already mentioned, but also because of slope, and the washing-out effect of the greater volume of rain falling every year. But it is just as liable to present itself, wherever the rainfall is scanty and the evaporation great, as it is in the typical desert regions dealt with by the author. The writer of this article had the interesting experience, during the last seven years of his work in India, of fighting this evil . and growing sugar cane, one of the least resistant of crops, on saline land the irrigation of which was from a series of more or less brackish wells. It would be a mistake to assume that the people of India, with their highly developed systems of agriculture, have made no effort to counter the action of this insidious enemy to crop production. The remedies employed are practically endless, varying from simply scraping away the efflorescence (by which with little labour one-third of the salt concentration may be removed at a time), through palliatives such as carting silt on to the ground in their annual cleaning out of the irrigation tanks, introducing a rotation with some salt-resistant crop, such as irrigated ragi (Eleusine coracana) or even growing babul (Acacia arabica) for a term of years, and thereby making a profit out of it, or digging in a green manuring crop, to flooding the land when it is possible to do so. Many of these remedies were tested by the writer, with varying results; and ultimately success was obtained by enlarging and using the well which had the sweetest water and using it in sufficient quantity to mitigate the evil effects of its brackishness, green soiling, and introducing a suitable rotation after it, with sorghum immediately before plant ing the sugar cane

Irrigation extends throughout the length and breadth of India, and is not owing to any deficiency in the total annual rainfall, but rather to its unequal distribution over the year. This is characteristic of the Old World continental masses, as contrasted with the New, where the

ram is more or less equally distributed (and many British African colonies) is in the region of periodic rains, there is usually a short period each year when heavy rains fall, this being followed by a longer period of little or no ram. The growth of crops during the ramy season is insufficient to provide food for the great mass of population, and the excess water has thus to be conserved as much as possible for growing additional crops during the rainless period also. This, of course, is more especially the case with crops requiring much water, such as rice, which is grown in six mehes of flowing water throughout its growing period, and sugar cane which, in the peninsula at any rate, needs water at frequent intervals throughout the year. The large area under rice has already been referred to, and there are some three million acres of sugar cane grown Alkali is rarely a matter of serious moment in the peninsula, either as regards rice or sugar cane, or the various other crops irrigated; and much the same applies to the great irrigated areas farther east

The duty of water is known in a rough-andready way for most of the crops grown, that is, the small quantity needed at first, the great increases when the roots have developed and the leaves reach their maximum expanse, and the shutting off of water when ripening approaches. But there is a fine field open for scientific study in this matter; for example, along the lines adopted by the Howards, as to whether equally good crops of rice may not be obtained by using less water, and thus extending the area, which is badly needed: most of India is very like a desert when the dry spell has had sway for some time. Much of this irrigation is on undulating land, and full advantage is taken of this: the Indian cultivator, without the aid of instruments, has an uncanny knowledge of the problem of leading the water from field to field in the right direction. There are few of the great flat areas of the reclaimed deserts referred to by the author, and the gradients of rice are surprisingly steep in places.

Attention may be directed, in conclusion, to the work done in recent years in the Hawaiian Islands, where the crop is almost entirely sugar cane, and where the theory and practice of irrigation has been very fully worked out as regards this crop In three of the four islands of the group where the sugar cane is grown, the great proportion of it is irrigated. There is a plentiful supply of rain brought by the trade winds and falling on the east sides of the islands, but the amount drops practically to desert conditions on the west. This is countered by collecting the surplus rain on the eastern side and carrying it by tunnels through the mountains and by aqueducts across the valleys from one side to the other, until actually more cane is grown on the western side than the Seepage is countered by lining the eastern. channels with reinforced concrete made in slabs It was found that the grit in the on the spot water seriously abraded the sides of the canals, so a system of settling tanks has been instituted

with very satisfactory results. But the most remarkable fact is that irrigation has been found to pay, even where the rainfall is heavy enough to grow luxuriant crops of cane. This can only mean that the duty of water has been very carefully worked out

Such, indeed, is the case Every estate is mapped out with contour lines, and a whole series of canals, ditches, and so on, is drawn on these plans; and the amount of water given to each field or section is frequently measured, and recorded throughout the growth of the canes Numerous curves are prepared, on which a great deal of information is presented. One of the most remarkable of these is the curve of profitable

irrigation which can be applied for each month of the twenty-four during which the cane is in the ground. Few countries can follow Hawan in the vast expense involved in its irrigation system, but many useful suggestions would doubtless be obtained from a careful study of the work done in this group of islands by all interested in the duty of water. The difficulty, mentioned by Dr Keen, as experienced in cultivation because of the irrigation channels, lastly, is got over in various ways . by the obvious one, of using elongated plots as units, by movable pipes for the last distribution of water; and even by the use of overhead water sprinklers, also removable, in place of irrigation furrows C. A. B

### The Future of the Smithsonian Institution, Washington.

MEN of science in Great Britain had regretfully known for some time, through correspondence with friends in the United States, and by sundry opportunities of personal intercourse and discussion, that all was not well with the Smithsonian Institution in respect of its future scope and activities—that, notwithstanding the achievements of the past eighty years (it received its charter in 1846), perplexing uncertainties had now arisen regarding the specific objects which the organisation should direct and control. The Smithsonian is, in fact, at the cross-roads of endeavour, largely due to the very magnitude and completeness of its early conceptions.

Aware, in fullest measure, of their onerous responsibilities, the Chancellor of the Institution. Chief Justice Taft, and his colleagues on the Board of Regents, decided to summon a conference of representative American citizens, professional and lay, "To advise with reference to the future policy and field of service of the Smithsonian Institution." This conference took place at Washington on Feb. 11 last. Only three days earlier the death had occurred of Dr. C D. Walcott, who had been Secretary of the Institution since 1907. From the report of the proceedings, which is now available, it is evident that the problem set, in chief, the provision of adequate funds for maintenance and continued development, received sympathetic recognition Among those present were such well-known men as Dr. W. W. Campbell, President of the University of California; Mr. Robert W. Bingham (Kentucky); Mr Charles F. Brush (Ohio), Dr Simon Flexner, Director of the Rockefeller Institute for Medical Research; Mr. Robert P Lamont (Illinois); Dr Merriam, president of the Carnegie Institution; Mr Ogden L. Mills (New York), Dr H. F. Osborn, Dr. S. W. Stratton, president of the Massachusetts Institute of Technology; Dr. George E. Vincent, president of the Rockefeller Foundation; Dr W. H. Welch, of Johns Hopkins University, and Mr Robert Winsor (Massachusetts).

The Smithsonian Institution is everywhere such an accepted factor in the world of science that few, perhaps, are immediately prepared to recall its

initial testamentary story, or the genesis of the foundation which perpetuates the name Smithson.

James Smithson was an Englishman. In his earlier years he was known as James Lewis Macie, his mother being the widow of James Macie, a country gentleman, who had resided near Bath. Born in 1765, young Macie was in due course entered at Pembroke College, Oxford, as a gentleman commoner, graduating there in 1786. Chancellor Taft, in his opening address to the recent Conference, recalls, neglecting needless reticence, that Macie was the natural son of that Hugh Smithson who, from the baronetey of the realm. became the first Duke of Northumberland. At Oxford, Macic showed a marked predilection for scientific studies, and, as Dr R. T. Gunther has recently pointed out (NATURE, April 2, p. 492), opportunities for such pursuits actually existed at Oxford at the period of his entry. Finally, in digression, the bar sinister on Macie's escutcheon was met, after his father's death—the precise date is unknown—by a successful application to the Crown to assume the name of Smithson.

Our Royal Society elected Macie a fellow on April 19, 1787, when twenty-two years old, and on the subjoined certificate: "James Lewis Macie, Esq., M.A., late of Pembroke College, Oxford, and now of John Street, Golden Square, a gentleman well versed in various branches of Natural Philosophy, and particularly in Chymistry and Mineralogy, being desirous of becoming a Fellow of the Royal Society, we whose names are hereunto subscribed do, from our personal knowledge of his merit, judge him highly worthy of that honour and likely to become a very useful and valuable member—Richard Kirwan, C. F. Greville, C. Blagden, H Cavendish, David Pitcairn."

The first scientific paper of the newly elected fellow was read on July 7, 1791, before the Royal Society, and in the name of Macie It was published in the *Philosophical Transactions*. According to the late Dr. S. P. Langley, the name of Smithson is first certainly known to have been used by him in connexion with his second communication to the Royal Society, read on Nov. 18, 1802.

Smithson died on June 27, 1829, at Genoa. Three years earlier he had made a will whereby he bequeathed (in case of the death of a nephew without heirs) his entire estate "to the United States of America, to found, at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of

knowledge among mcn."

The proposed gift was first publicly announced by President Jackson in a message to Congress in 1835. The amount of the fund devolving was £111,389. We see that the donor had relegated his alma mater, and had passed over an ancient scientific foundation. Born in France, brought to England and naturalised, and in later years living among foreigners, Smithson may have become so detached in thought and habit that old ties, old associations, were forgotten. Conjecture surrenders to fact. But the use made of the gift as the keystone of an arch of knowledge was altogether unprecedented in character and optimism.

Ten years of travail and debate preceded the launching of the Smithsonian. The problem was to define knowledge and determine how best to increase and diffuse it. What was to be inscribed on the arms of the direction post? Five successive Congresses discussed the question. Many diverse propositions were made. Towards the end of

1846 a charter passed into law.

The first secretary was Joseph Henry, professor of physics and of natural history at Princeton. To his vision, zeal, and resource was due the organisation and the planning of projects for the Smithsonian Institution. Henry was succeeded by Prof. Spencer F. Baird (1878), biologist, he in turn by Dr Samuel Pierpont Langley (1887), physicist and astronomer; next by Dr. Charles D. Walcott (1907), geologist and

palæontologist.

Activities of great public value arose through Henry's influence; for example, the Weather Service, the U.S. Fish Commission, the system of International Exchanges of Scientific Literature, and the Bureau of Ethnology. There followed, under later leadership, the National Zoological Park, an Astrophysical Observatory, and other notable enterprises, each fostering research and progress. For long they were financed from the income of the private Smithsonian endowment. Congress now apportions certain sums for their maintenance, because, Dr C. G. Abbot remarks, "the public needs them." Most of them are, however, still under Smithsonian administration. With reference to Congressional appropriation, we gather from Senator Reed Smoot, who spoke at the Conference, the unwelcome information that "the handicap under which the Smithsonian Institution labours in its relations with Congress is that Congressmen know so little about it." The Institution co-operates through specimens, instruments, men, and advice, with scientific agencies throughout the world. It has promoted the scientific survey of North America, and has taken part in no fewer than 1500 expeditions in

various regions. Researches by men not directly connected with the Institution are subsidised at intervals, these not Americans alone, but Englishmen, Frenchmen, Germans, and other nationals. The Smithsonian publishes new knowledge gained by its own and outside workers in the form of large memoirs and smaller original papers, which, with unique liberality, it distributes to 1500 libraries and learned bodies in every country of the world Its reprints in the familiar Annual Report of informing articles of distinction are well known This was a matter in which Dr. S. P. Langley took personal pride and interest. Here it may be recalled that during Secretary Henry's term of office, he addressed a letter to the British Association pointing out the advantage of publishing systematic lists of the titles of scientific papers As a sequel the Royal Society began its well-known "Catalogue of Scientific Papers."

Some quotations from recorded speeches at the Conference will serve to convey the general views of at least a few of the representatives present. Characteristic throughout was the enthusiastic affection entertained for the Smithsonian. Dr. C. G Abbot gave an able summary of accomplishment. "Considering," he said, "the immense benefit which the foundation has brought to our country, it would be ungrateful to transform the private memorial character of the Institution into a Government agency. The Smithsonian is not just another institution; it is not just another museum, not just another university." Dr Flexner is of opinion that "the Smithsonian makes an appeal on the one hand strongly to Government and equally to private philanthropy; because the fruits of science, however garnered, are something of which the public as a whole, without distinction, enjoys the benefit." Again, Dr. W. W. Campbell: "Men of the type of university professors or investigators are in need of favourable environment; they are in need of tranquillity; they must be men without worries; there should be a continuing financial policy." Dr. Osborn, as regards scientific research: "I remember well when Secretary Langley was laughed at for diverting the funds of the Institution to experiments in flight. would suggest that they were not valuable to-day, when the world is covered with airplanes?" Also Dr. George E. Vincent: "I am sure that out of this Conference there will develop a plan by means of which private citizens and the Government of the United States will combine to make this great Institution still more influential in the future."

In Great Britain many friends will watch with deep interest the effort that is being made to re-awaken and intensify appreciation of the Smithsonian Institution. The Conference delegates stand high in public esteem in the United States; they are of the type capable of moving men to action where action is imperative. may be hoped that a satisfactory response will ensue respecting the 'field of service' under discussion. T. E. JAMES.

### University College, London, 1827-1927.

THE centenary celebrations of University College, London, which were maugurated by Their Majesties the King and Queen on Thursday, June 23, continued day by day until the end of the ensuing week. To-day, July 2, they are to come to a joyous conclusion with a dance in the Great Hall, a building recently acquired and reconstructed by the College and dedicated as a war and centenary memorial on June 24 by H.R H Prince Arthur of Connaught. The celebrations have been on a scale befitting their august patronage, and the programme of receptions, divine services, concerts, lectures, and demonstrations arranged for the delectation of the visitors, shows that the College was determined to rise to the height of this opportunity Specially noteworthy have been the lectures, more than forty in number, including many by such well-known authorities as Sir Flinders Petrie, Profs. J. Norman Collie, M. J. M. Hill, A. V. Hill, and Daniel Jones, and Sir Frederic Kenyon. These, and numerous demonstrations and exhibitions of great interest, were freely open to the public

The circumstances in which University College came into being are vividly recalled in the brilliant oration pronounced by the Provost, Sir Gregory Foster, on Mar 25, 1926, before the Union Society of the College at a gathering organised by it to commemorate the names of founders and other illustrious members The founders' names selected for mention on that occasion were Dr. George Birkbeek and Isaac Lyon Goldsmid The former, who also founded, in 1823, the Birkbeck Institute, now enrolled as Birkbeck College among the Schools of the University, was engaged about that time in association with Henry Brougham, afterwards Lord Brougham, in a campaign for promoting the education of the people, a campaign which led to the foundation of the famous Mechanics' Institutions. Goldsmid was a leader in the efforts that were being made in favour of religious toleration. Both movements were important factors in producing an atmosphere favourable to the reception of a scheme for a

metropolitan university.

Many other distinguished men had, for several years before the laying of the foundation-stone of University College in April 1827, been canvassing the merits of such a scheme. Among them were the poet Thomas Campbell, George Grote, Joseph Hume, the Marquess of Lansdowne, Zachary Macaulay, James Mill, the Duke of Norfolk, and William Tooke Francis Place, the "radical tailor of Charing Cross," also interested himself in the matter. It was Thomas Campbell who first put the project on paper Fired with enthusiasm for the idea incorporated in the constitution of the then newly founded University of Berlin of devotion exclusively to the interests of science and learning without bias towards any particular creed or school of thought, he wrote a letter to Lord Brougham, which was published in the Times of Feb. 9, 1825, advocating a "proposal for a

metropolitan university for effectively and multifariously teaching, examining, exercising, and rewarding with honours in the liberal arts and sciences" youths of from fifteen or sixteen to twenty or more years of age whom their parents could not afford to send to Oxford or Cambridge. This letter, despite disparaging editorial comments, led directly to the foundation of the University College. The movement was borne forward on a wave of generous enthusiasm for the advancement of learning and revolt against the dominance of academic particularism, privilege, protection, and repression.

To the wisdom and foresight of the founders Lord Balfour paid a remarkable tribute in his speech at the dedication ceremony in the Great Hall on June 24 last. Their work stands out, he said, as being little short, if short at all, of the boldest genius. "How many were there — who saw the great part science was going to play in civilisation? Very few But they foresaw it, and while foreseeing it . . . they did not ignore or minimise the humanities"

It is precisely this judicious appreciation of the place of science in university education, coupled with a fine record of achievements in the fields of scientific research, that constitutes the most cogent argument for our gratitude and further support. We are reminded that its chemical laboratory, opened in the College in 1828, was one of the earliest places in England where chemistry was systematically taught. In that department Sir William Ramsay, following a line of distinguished predecessors—Edward Turner, Thomas Graham, A. W. Williamson—did fundamental work on the gases argon, neon, and helium, and from it went forth many a young chemist trained by him and eager to follow in his footsteps. Biology, like chemistry, was almost unknown as a subject of university study until University College began teaching it, and systematic medical education based upon scientific principles, carried out in a hospital built for medical purposes, was equally a novelty Prof. Sharpey introduced the teaching of histology as a branch of physiology, and two of his pupils, Sir, Michael Foster and Sir John Burden Sanderson, carried his methods to Cambridge and Oxford. The department for "Engineering and the Application of Mechanical Means to the Arts, which figures in the first programme of studies, did not immediately materialise, but later on a chair of engineering was instituted which was held successively by Profs. Vignoles, Hodgkinson, Fleeming Jenkin, and Alexander Kennedy Here, too, the College blazed a trail that has been followed by the other universities.

In short, the College is justified in claiming that it has played no small part in that progress of science to which is largely due the great transformation in the religious, the political, the social, and educational aspects of our national life which has taken place in the past hundred years. Nor should we forget that the College was a pioneer in

giving the advantages of higher education to women, in establishing a complete university school of fine art, and in introducing the teaching of librarianship and phonetics

As the circles of its influence have widened and the fame of its teaching has spread, the College has attracted more and more students, including many from far distant lands. In the past twenty-five years this growth has been rapid—from 1098 to 3228. Though the fees have been raised the increase in the fee income is but a fraction of the increase of expenditure entailed, and the College must look for fresh sources of revenue. The Centenary Appeal asks for £520,000, including £235,000 for endowment of chairs, of which seventeen are at present without endowment, and seventeen others are inadequately endowed. Up to June 18 the appeal had brought subscriptions

amounting to £117,440, including £43,000 contributed by past and present students, and a grant of £25,000 by the Rockefeller Foundation for endowment of the Department of Pharmacology, while on June 23, the first day of the celebrations, appeared an announcement in the *Times* of a turther gift of £93,178 from the same Foundation, supplementary to the gift of 1921, for the Departments of Anatomy and Physiology

Of good omen for the future of the College is the purchase by the University of London of eleven and a half acres of land in its immediate vicinity. This momentous transaction, made possible by a gift of £400,000 from the Rockefeller Foundation and a Government grant of £125,000, synchronises auspiciously with the centenary celebrations, and suggests vistas of further progress for the College not less glorious than that already achieved.

### News and Views.

There would appear to be good ground for believing that another sensational archaeological discovery has suffered the fate of many of its kind in the past and has failed to stand the test of examination by experts. The remarkable character of the finds at Glozel, in which objects of neolithic culture akin to the Ægean, inscriptions on clay tablets, and engravings of animals on pebbles were found in association, aroused no little scepticism at the time of their discovery; but Dr. Salomon Reinach was convinced of their authenticity and, relying upon their evidence, put forward the theory that a degenerate Magdaleman culture had lasted so late as 4000 3500 B.c., with the consequence that the Magdaleman must be placed so low as 5000 B.c. The resemblance of the script on the tablets to that alleged to have been found in a Portuguese dolmen in 1894 was immediately apparent. It has been stated that a confession of forgery has appeared in Belgium, but confirmation of this is not yet to hand. In the issue of Antuquity for June, Mr. Crawford gives in some detail the results of an examination of the objects themselves, and subjects the circumstances of the find to a critical scrutiny based upon a personal inspection of the ground. He is persuaded that the objects in question are forgeries. His case is convincing; all the more so in that his opinion coincides with that of the Abbé Breuil.

In connexion with the centenary celebrations of University College, London, it will be remembered that George Grote, the distinguished historian and publicist, was in especial measure the early friend and counsellor of the College. He was holding office as president at the date of his death in 1871. It is worthy of recall that on July 7, 1863, eight years before Grote died, he communicated the following wishes: "I desire that after my decease my cranium shall be opened by the Professor of Anatomy in University College, London, or by some other competent anatomist. I desire that my brain shall be carefully weighed and examined, and that

the weight thereof shall be communicated to Prof. Bain, together with any other peculiarities which may be found, especially whether the cerebellum is deficient as compared with the cerebrum." After the historian's decease, Prof. Sharpey, finding that Bain desired to be relieved from participation in the foregoing directions, entrusted the autopsy to Prof. John Marshall, who published a description of the brain (with photographic illustrations) in the Journal of Anatomy and Physiology (vol. 27, 1893). It would be of interest to learn in whose keeping the brain remains. It is not at University College,

The Electricity (Supply) Act, 1926, has raised the hopes of consumers for getting a cheaper supply of electricity in the immediate future. The Act gives facilities for shutting down all uneconomical generating stations and erecting and enlarging modern works equipped with the best generating plant available. The immediate problems in connexion with transmission and distribution are the obtaining of way leaves and the most economic methods of creeting overhead lines. Once it is conceded that no landowner should have an absolute veto to prevent transmission lines passing over his property, it is highly desirable that the present method of obtaining way leaves should be simplified. It is true that the Post Office is in a specially favoured position and has almost absolute powers to prevent its telegraphs and telephones being interfered with either by leakage or induction from power-lines, but it has never used its powers unreasonably. Hitherto, electrical development in Great Britain has been based on coal conservation, but the heavy costs of the transmission lines makes it probable that 'capital' conservation is equally important. We think that by far the most promising method of reducing costs is to utilise to the utmost all the plant in the station. To have the great bulk of the machinery lying idle for most of the day is most uneconomical. Some method of storage must be used and each machine run to its full capacity. Periods of light load are a loss to every

undertaking. The most promising method of fully utilising the plant in winter time is to have some low grade thermal storage system in consumer's houses for hot water and room heating. Several systems for this purpose are being tried, and electrical engineers would do well to encourage them. Once they become general, considerable reductions in the price of electricity will be possible.

IT is highly desirable that nothing be done to detract from the beauty either of a town or of a countryside. Yet just as it is necessary for an individual to consider ways and means, so it is necessary for us to encourage industry even at the expense of detracting from the beauty of the land in which we live. Railways, telegraph poles, coalpits with their mountains of shale, and brick-fields, for example, have come to be regarded as necessary evils. Recently, in the Morning Post, the Countess Bathurst expressed apprehension lest the Electricity Bill lead to the disfigurement of beautiful parts of Great Britain by overhead electric mains. She says this has already happened in Switzerland and Italy. The average visitor to the continent rarely complains of the unsightliness of the lattice towers supporting overhead wires or even of the open-air transformer substations. A few grumble when they see a row of lattice poles going over the shoulder of a mountain peak, but the inhabitants have got accustomed to it, and, as a rule, regard it with pride. The Countess Bathurst suggests that the mains which form the 'grid' of the Government scheme for Great Britain should be placed underground. But if this were done, the transmission pressure would have to be greatly reduced and the era of cheap electricity would be in the distant future. It is quite possible that when we know more about the causes which make highpressure electricity break down insulating materials, electrical engineers may be able to construct cables to withstand the 135,000 volts which is the standard pressure that will be used. Seeing that many countries are competing for the world's markets, it would be foolish to handicap even temporarily our industries merely for æsthetic considerations. The authorites responsible, however, should bear in mind that 'safety' is not the only consideration, and that the colours of the lattice poles and auxiliary devices should harmonise with their surroundings.

A flight across the Beaufort Sea is now being planned by Mr. G. H. Wilkins. According to Science Service of Washington, he proposes shortly to leave Point Barrow, Alaska, and set a course for about lat. 84° N., long. 100° W., which should take him over the position of Peary's reported Crocker Land. Thence he proposes to cross Ellesmere Island to Etah in Greenland. If the aeroplane is forced to descend on the way, the party hope to be able to return on foot, living on seals during the march. Even if all goes well, Mr. Wilkins points out that there may be considerable delay in his return owing to the poor communications with Etah and Ellesmere Island. Science Service also records a flight made by Mr.

Wilkins and Mr. B. Eielson from Point Barrow on Mar 29 of this year. On that occasion, with fuel for 1400 miles in calm weather, they proposed to fly 600 miles north-west, then 200 miles south, and then back to Point Barrow, thus investigating the southern borders of the Beaufort Sea. Engine trouble caused a forced descent about 550 miles north-west of Point Barrow. A sounding of 'about three miles' indicated that he was north of the continental shelf. The exact position is not given. The flight was resumed, but a second forced landing soon had to be made. Eventually, by drifting with the ice and sledging. they returned to Point Barrow. Mr. Wilkins maintains that, contrary to the belief expressed by Capt. Amundsen and others, there are plenty of good landing places on polar pack.

RECENT acquisitions of the British Museum (Natural History) include the following. The Zoological Department has received a pair of elephant tusks of almost record size, presented by the Government of Kenya Colony. These tusks, which weigh 168 lb and 166 lb and are 9 ft.  $2\frac{1}{2}$  m. and 9 ft.  $2\frac{1}{4}$  m long respectively, were at the British Empire Exhibition, The Department is sharing with the Museum d'Histoire Naturelle, Paris, the specimens collected in French Indo-China by M. J. Delacour and Mr. Willoughby P. Lowe. The British Museum consignment includes the rare carnivore Chrotogale. The most important purchase recently sanctioned by the Trustees is a large fossil amphibian obtained by Dr. B. Dunstan from hard sandstone of Triassic age near Sydney, N.S.W. The specimen, which is about 9 ft. long, is in the form of hollow moulds left after the decay of the bones. It will be possible to take plaster casts from these and to mount them as a skeleton, complete except for a few toe-bones. The specimen is one of the roofed-skull labyrinthodonts and belongs to the group Stereospondyla. Although fragments of fossils of this group have been known for more than a century, there is only one other specimen in which even a portion of the skeleton is associated with the skull, and that is at Stuttgart. During the last century the chalk-pits of Charlton, Northfleet, Lewes, and similar localities in Kent and Sussex, yielded some fossil starfishes, sea-urchins, and remains of fishes in an exceptional state of preservation. The late Mr. James Fox made a notable collection of such objects, and the Museum has now been able to obtain such specimens as it required. The Trustees have authorused the purchase for the Department of Botany of the late Mr. F. W. Payne's collection of 8000 microscope slides of diatoms. The slides are of special interest and value, because only one species is represented on each. The diatoms are mounted whole and also with the frustules separated, and arranged in different ways so that a complete examination can be made.

THE discussion initiated by the Illuminating Engineering Society at the Stationers' Hall on June 14, on the lighting of printing works, served a useful purpose in helping to make known the results

of the valuable investigation conducted by the committee working under the Department for Scientific and Industrial Research. Investigations tracing the influence of conditions on industrial output and efficiency require great care and patience, and the co-operation of the industries concerned is essential in order that conclusions may be willingly accepted. In this case the impartial nature of the Committee and the scientific standing of its members entitle its findings to respect, and the sympathetic co-operation of the Joint Industrial Council for the Printing Trades, the secretaries of which joined in the discussion, has been most valuable. The chief conclusion so far arrived at-that an illumination of the order of 20 foot-candles is necessary for full efficiency in typesetting by hand—is sufficiently striking Probably few composing-rooms receive such a high illumination at present, and a considerable advance may now be anticipated. The conclusion is probably broadly applicable to other forms of fine work, and the lecturer, Mr. Weston, showed that it is economically justified. Numerous points in regard to the best form of lighting in composing-rooms (e.g. whether direct or indirect, general or local, etc.) are still under discussion. From the proceedings at the meeting, it would appear that a combination of moderate general lighting with high local illumination provides the best solution, and this may apply to other exacting forms of work where high illuminations are required.

Much sooner than was expected, some brief accounts of the great Kansu earthquake of May 23 (May 22, Greenwich time) have been received (Times, June 21, 22, and 24), but it seems clear that they come from the outlying zones of damage, not from the central region. At Langchow, the capital of the province, two pagodas were destroyed. The cities of Kanchow and Suhchow were only slightly damaged. So far as is yet known, the city of Liangchowfu, in the northern part of the province, seems to have suffered most. There was an early shock at 4 a.m. (local time), followed at 5.30 a.m. by the principal shock that lasted two minutes and rumed half the city. In this district the telegraph lines were thrown down and many lives were lost.

THE famous Oxfordshire stone circle known as the Rollright Stones, with the outlying cromlech, "The Whispering Knights," has been on the market as part of the estate of Little Rollright Manor. Considered by many archæologists to be older than Stonehenge, no ancient 'temple' is more deserving of the protection of the State, not only within the circuit of the unclimbable iron fence that closely surrounds it, but also by the preservation of a sufficient tract of open land all round, that the locality may not be spoiled by the erection, as at Stonehenge, of distracting and unworthy buildings in the close vicinity of the monument. In "The Cult of the Circle Builders," Mr. E. M. Nelson adopted a unit of length equal to 0 95 of the English foot as the unit employed by the builders of the Circle at Denber's Pasture in Yorkshire and elsewhere The diameter of the Rollight stones is exactly 100 of such feet, and the lay-out of the outlying associated stones appears also to be based on certain proportions, which according to Mr. Nelson were represented by the numbers 3, 7, and an ancient value of  $\pi$ . In any case there is no other monument of the science of the British Bronze Age now extant in the midland or eastern countries than the Rollright circle

THE Rothamsted Experimental Station, Harpenden, will have an instructive exhibit at the Royal Agricultural Society's Show which opens at Newport (Mon ) on July 5. The central portion of the exhibit illustrates the development of types of experiment at Rothamsted from 1843 to the present time, and it shows by means of a precision scale that results now obtained in a single year may be a hundred times as valuable as an experiment carried out twenty years ago Effects of treatment of different plots for grass, mangolds, potatoes, and swedes are shown by actual turves and plants, and the specimens bring out the fact that balance between the different dressings applied to various crops is of essential importance. On the biological side, control work is illustrated, such as parasites of earwigs to combat the earwig pest in New Zealand, and investigations to keep down blackberry, gorse, ragwort, and other injurious plants by means of insects. Results of recent work of the Bacteriological Department of Rothamsted in connexion with the cultivation of lucerne are also included in the exhibit of the Station.

Biology lecturers at agricultural colleges and institutes, as well as teachers in rural schools where the curriculum includes elementary economic biology or nature study, will find that a new series of 'relief plaques' or tablets, lately put on the market, offers an effective aid in the work of giving instruction concerning insect pests and fungoid diseases of farm Most of the tablets measure 12 in, by 10 in, crops though some are larger. Against a black background there is modelled a raised or relief representation of a crop plant of the farm suffering from a fungoid disease or attacked by some well-known insect pest the whole being shown in natural colours. Frequently two, or even more, diseases of the same plant are represented on a single plaque. The models are well executed, and they should be more effective for class demonstration than ordinary pretorial representations of the various pests. Accompanying every plaque is a description of the pest the activities of which are indicated, and of recognised methods of control, written by a member of the staff of the Royal Agricultural College, Circnester. The tablets have been prepared in Germany by the Deutsche Hochbild-Gesellschaft of Munich, and are reported to have been adopted at a number of agricultural educational institutions in continental countries. We understand that an English company is being formed to take up the business of the manufacture and sale of these, and other similar series of educational relief plaques, in Great Britian.

UNDER the Buths and Deaths Registration Act, 1926, which came into force on July I, the registration of still-births by the Registrars of Births and Deaths becomes obligatory. It has long been felt that the vital statistics of Great Britain have been deficient by non-registration of still-births. The Ministry of Health has issued leaflets (Circulars Nos. 802 and 802a), addressed to supervising authorities under the Midwives Acts and authorities carrying out maternity and child welfare schemes respectively, detailing the procedure under, and the principal provisions of, the new Act

In his recently published presidential address to the Quekett Microscopical Club, Sir David Prain recalled the establishment in his first medical school in 1878 of laboratory classes in botany, zoology, and physiology, so that, with the class on histology, there were in two years of study four courses involving to a greater or less degree microscopic work. were assured on the authority of four earnest teachers that it was our duty to be able to use the microscope. . . . No hint, however, was ever given us that to work with the microscope may be a source of pleasure Little wonder that to some microscopic work appeared a disagreeable necessity, that to many it remained a matter of course; and that to only a few was vouchsafed the privilege of penetrating the secret of the Quekett Club." It is still unfortunately the case that few students either in biology or in medicine have penetrated this secret, but perhaps the hint that pleasure may be found in work with the microscope is as rarely given as in 1878.

THE president and council of the Royal Society have recommended Mr. Stanley Baldwin for election into the Society under the special statute which permits the election of persons who, in their opinion, either have rendered conspicuous service to the cause of science or are such that their election would be of signal benefit to the Society.

THE Government of India has invited the Far Eastern Association of Tropical Medicine to hold its seventh Congress in India in 1927, and the Congress will open at Calcutta on Dec. 5. The president is Major-General T. H. Symons, Director-General of the Indian Medical Service, and the general organising secretary, Lieut.-Col. J. Cunningham, I.M.S., from whom all information may be obtained at the Pasteur Institute of India, Kasauli, Punjab.

WE understand from A.S.L.I.B. (the Association of Special Libraries and Information Bureaux), 38 Bloomsbury Square, London, W.C.1, that the "Directory of Sources of Specialised Information," which the Association is preparing under the editorship of Mr. G. F. Barwick, is approaching completion. Mr. Barwick would like especially to include some more collections in the possession of private individuals.

At the Royal Statistical Society's annual general meeting held on June 21, it was reported that the

number of fellows on the roll is now 1056, and shows a small increase over last year. In the course of the proceedings a proposal was made that the existing letters, F.S.S., denoting fellowship of the Society, should be changed so as to include an indication of the status of the Society as a Royal Society. The alteration was opposed on behalf of the Council, and after some discussion the motion was withdrawn. Viscount D'Abernon was elected president for a second year, and the other officers of the Society were also re-elected

THE Royal Photographic Society of Great Britain will hold its seventy-second annual exhibition in September and October of this year. This is the most representative exhibition of photographic work in the world, and comprises the recent achievements of photography, both pure and applied. It is desired to make the Scientific and Technical Section as representative as possible, and with this end in view exhibits are invited, which may comprise apparatus, models, prints, diagrams, transparencies, or any other form of record illustrating the applications of the photographic method to biology, botany, mineralogy, microscopy, geography, geology, spectroscopy, photometry, engineering, colorimetry, textiles, etc. Exhibits should be sent before Aug. 13, addressed to the Royal Photographic Society, 35 Russell Square, W.C.1. All communications should be addressed to the honorary secretary of the Scientific and Technical Group, Olaf Bloch, 35, Russell Square, W.C.1.

The issue of the Scientific American for May contains an account of the survey of a portion of Alaska by means of three all-metal aeroplanes of amphibian type with 7 officers and 40 men from the United States Naval Air Station at San Diego. More than 40,000 square miles of rugged unexplored country was surveyed, a fourth of the survey being completed in a fortnight. A lake nine miles long and four wide was discovered at an altitude of 1500 feet, and will be used to furnish 100,000 electrical horse-power. Extensive forests of spruce, pine, and hemlock were also found, and a paper mill is to be established in the neighbourhood.

THE Report of the Museum at Valletta, Malta, for 1925-26, records the exploration of many archæological sites; the handle of a neolithic clay vase representing a ram's head is called by Prof. Zammit "the most important find of the year." The material illustrating local natural history, transferred from the University Museum in 1924, has now for the most part been placed provisionally on exhibition, and a summary catalogue of the constituent collections, as well as of recent accessions, is contributed to the report by Mr. Despott and should prove useful.

THE. Section of Geodesy of the Geodetic and Geophysical Union has recently published No. 9 of the Bulletin Géodésique, in advance of the still unpublished Nos 7, 8. Its contents are partly in English, partly in French. Besides a useful bibliography of recent publications, and an international

chronicle of geophysical organisation and work in various countries, it contains four articles of general The first is a reprint of Dutton's address at Washington in 1889 on the contractional and isostatic hypotheses in physical geology. Two other articles deal with new geodetic measurements in Poland and France, while the last article describes a portable automatic tide gauge produced by the US. Coast and Geodetic Survey.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Research chemists and a research physicist at the Building Research Station, Garston, Watford-The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (July 11). A lecturer in the zoology department of King's College, London--The Secretary, King's College, Strand, W.C.2 (July 12). A secretary and treasurer of the Rowett Research Institute—The Secretary, Rowett Research

Institute, Bucksburn, Aberdeen (July 12). A bacteriologist in connexion with the Dairying Research Division of the Ministry of Agriculture for Northern Ireland—The Secretary, Ministry of Agriculture for Northern Ireland, Wellington Place, Belfast (July 15). An assistant lecturer in geology in the University of Manchester -- The Registrar, University, Manchester (July 16). An evening lecturer in philosophy and logic at Birkbeck College-The Secretary, Birkbeck College, Fetter Lane, E.C.4 (July 16). An assistant in the department of economics of the South-Eastern Agricultural College, Wye, Kent-The Principal, South-Eastern Agricultural College, Wye, Kent. A half-time demonstrator and half-time research assistant familiar with X-ray apparatus and its use in crystallography, and a research assistant familiar with the chemistry and physics of photosynthesis, in the department of physics of the University of Toronto -Prof. J. C. McLennan, Athenaum Club, Pall Mall, S.W.1.

### Our Astronomical Column.

COMET PONS-WINNECKE. - Recent observations. both visual and photographic, indicate a very definite central condensation, 10" in diameter or less, permitting accurate measures to be made. According to usual views of comets, this indicates a welldefined meteoric cluster, not exceeding 250 miles in diameter. It is rather a puzzle how they have maintained this compact regular formation through at least 108 years, in view of repeated large perturbations by Jupiter. It suggests that some force other than gravitation may help to keep the constituents together.

The comet was seen with the naked eye on several occasions by those who knew exactly where to look for it; it could be seen in the telescope before the close of twilight. Since its distance is only about a quarter of that of Eros in 1931, it should be possible to derive a good value of the solar parallax, provided that nearly simultaneous observations are available from the southern hemisphere The distance on the night of June 26-27 was about 3,600,000 miles. According to a bulletin dated June 4, issued by Science Service of Washington, there is only one case known of a nearer approach of a comet to the earth. That is the comet 1770 I, known as Lexell's, which passed within 1,400,000 miles of the earth on July 1, 1770. Its coma then appeared 2\frac{1}{2} in diameter (Chambers, "Story of the Comets," p. 87).

The motion of comet Pons-Winnecke was so rapid that on a photograph with the Greenwich Astrographic taken about 1h on June 23, with 3 minutes exposure, it appeared as a narrow faint trail more than a millimetre long.

THE GREAT PERSEID SHOWER OF METEORS.—Mr. W. F. Denning writes: "This important stream commences at the end of June or beginning of July. It is desirable to ascertain the dates when the first and last members of the display are visible. From a discussion of thousands of recorded paths, between about June 21 and Sept. 10, I think that the limiting dates are June 25 and Sept. 5, a period of 72 days. But in consequence of the many feeble contemporary systems in play with radiants in the same region of the heavens, it is difficult to decide with absolute safety on the exact period over which true Perseids continue to fall. It would be a good plan to arrange simultaneous watches by a number of trustworthy

observers Meteors doubly observed yield radiants which are not affected with the same doubts as an object seen by one observer only. A meteor may be directed from the radiant of the Perseids and vet belong to another centre, whereas multiple records of the same object must give the correct radiant if the data are accurately recorded.

"The return of the Perseids this year takes place amid bright moonlight. The meteors, however, are often so bright and abundant on Aug. 11 and 12 that they well repay watching even when the moon is present."

The Spectrohelioscope. -- An article by Lee McCrao in the Scientific American for March gives an illustrated description of Prof. Hale's spectrohelioscope, which accomplishes visually the same work that the spectroholiograph does photographically (see also Nature, July 3, 1926, Supp. p. 1). It is not essentially new; the earliest spectroscopic observations of the solar prominences were made visually, and the method of the oscillating slit, which is the main feature of Prof. Hale's instrument, was tried in those days. But long experience has so greatly improved all the accessories that the method is now much more effective.

The article points out the many advantages of the visual over the photographic method; the photograph can only catch a particular aspect, whoreas the visual method, like a cinema film, shows the progress of events. Its action is more rapid than the photograph; further, it can pick out the regions of the sun where interesting developments are in progress, and follow them through their different stages.

Another advantage is that cruptions occur which change the wave-length of the line owing to Doppler effect. A record of these would be lost on the photograph, but can be obtained visually, since there is a device for altering the position of the slit. Knowledge has already been gained in this way regarding the nature of the whirling motion that occurs round sunspots. It is hoped to establish more accurately the relation between solar cruptions and magnetic storms on the earth.

Prof. Hale is trying to produce a simpler and cheaper form of the instrument, and hopes that it may lead to a more general and continuous watch

on the sun for detecting outbursts.

#### Research Items.

CELTS FROM KNOLE PARK, SEVENOAKS .-- Mr. J. P. T. Burchell contributes to Man for June a further note on the unorthodox association of polished celts and stemmed and barbed arrowheads from Knole Park. The celts, which have thin butts and pointed oval section, according to the Scandinavian chronology should belong to the pre-Dolmen period, but in England they have been found, as at Bexley Heath, in association with celts having a thin butt and square sides, and must be considered as having survived well into the Dolmen period. The celt with thick butt characteristic of the second Dolmen period in Scandinavia was not adopted in England. At Seamer Moor, Yorkshire, celts with thin butt and pointed oval section were found with expanding edges and incurved sides, together with kite-shaped arrowheads. In the passage graves of Scandinavia occur narrowbladed diggers, shaft-hole axes with expanding cutting edges and incurved sides, together with hollow-based arrowheads. It is suggested that some of the artefacts of the passage-grave period in Scandinavia and Britain are copies in flint of existing metal types of more southern lands The last period of Britain, the third phase of the Dolmen cult, is definitely of the Bronze Age, though the use of the metal is still deferred in Scandinavia. The Knole Park settlement, with its stemmed and barbed arrowheads typical of the encolithic period, cannot be much earlier than the times of the round barrows. The celts indicate that the settlement was occupied by descendants of the pre-Dolmen period and that they were under the influence of an alien race.

VERTICAL DISTRIBUTION OF MARINE MACROPLANKTON.—In a fifth paper on this subject (Jour. Marine Biol. Assoc, vol 14, No. 3, 1927, pp 557-608) dealing with the catches of a stramm ring-trawl, Mr. F. S. Russell gives particulars regarding the animals other than young fish, which have already been dealt with. The hauls were made at serial depths during the daylight at intervals between April and August 1926 and give a valuable series of records for many important plankton species. In general, Mr. Russell finds that most species have an optimum level in the water in which they live in the daytime, though this may vary according to weather and other conditions in ways not yet fully understood.

PHILIPPINE HYDROIDS.—The late Prof. C. C. Nutting reports (U.S. Nat. Mus. Bull. 100, 1927) on the hydroids collected by the U.S. Fisheries steamer Albatross in the Philippine region. Hydroids were taken at 58 of the 575 dredging stations reported for that cruise, which does not indicate an extraordinarily rich hydroid fauna. The collection represents 10 families, 27 genera, and 54 species, and affords many new records of species not hitherto found in the Philippine region. Prof. Nutting remarks on the relative scarcity of gymnoblastic forms, there being but three species belonging to this group, and one of these, the giant tubularid Branchiocerianthus imperator, was dredged outside the Philippine area in Japanese waters. Twenty-six species, almost one half of the total, belong to the family Plumularidæ. The author adds some remarks on the recent multiplication of names and the breaking up of old genera by Stechow, which tend in his opinion to confuse the situation, and he expresses his own preference for a conservative course m nomenclature.

Hybridisation and Variability.—'New Lights on Evolution' is the title of an address by Prof. E. C. Jeffrey (Science, May 13, p. 458), the burden of

which is an exposition of his well-known view that polymorphic genera of plants and animals are all hybrids. While formerly holding that hybrids were of no significance for evolution, he now appears to have adopted Lotsy's view that natural hybridisation is the only cause of variability. With all the ardour of a convert, he even maintains that Drosophila melanogaster is of hybrid origin, notwithstanding the abundant contrary evidence. The widespread occurrence of hybridism in flowering plants is recognised by many, but probably few would venture to see in it the sole effective cause of variation Similarly, the author believes previous crossing to be the cause of parthenogenesis, but he omits to consider Artenna salina and its tetraploid parthenogenetic variety in this connexion.

Tanaodon: a new Pelecypod Genus —A most remarkable pelecypod from the Middle Devoman of China has just been described by Mr. Edwin Kirk (Proc. U.S. Nat. Mus., vol. 70, art. 12). Externally it somewhat resembles Megalodon, and the author places it in the Megalodontida. The hinge, however, is strikingly different from that of any hithertoknown bivalve. The teeth form a series of elongate ridges disposed fan-wise, radiating from the umbo, and it is difficult to distribute them satisfactorily into cardinal and lateral. The author considers that eight may be reckoned as cardinal and three (or more) as posterior lateral. His figure shows thirteen of these ridges in all. Another interesting feature of the shell is the very prominent external lumbonopostero-ventral ridge, which at its point of origin at the umbones is raised into a sharp keel but becomes less and less prominent as it passes outwards. It reminds one of the similar keel in Hemicardium.

GRAVITY SURVEY OF KWANTO.—The recent issue (No. 2) of vol. 4 of the Japanese Journal of Astronomy and Geophysics is wholly devoted to a report of a gravity survey, using an Eotvos variometer, of the Kwanto district, which suffered a great earthquake on Sept. 1, 1923. The district has since been investigated along many lines of geophysical research: land and hydrographic surveys have shown that the vertical displacements of the bottom of the Bay of Sagamı, resulting from the earthquake, are more than a hundred times those of the land. In the present gravity survey, by N. Kumagai, 76 points were occupied, and the observations are carefully discussed and corrected for various sources of error, though further corrections are to be embodied in a later report. Unfortunately, few gravity observations dating from before the earthquake are available for the district, so that the observations of the present survey cannot be used to infer changes of density distribution resulting from the earthquake.

Positive Thermions.—The May number of the Journal of the Franklin Institute contains an account by Dr. C. H. Kunsman of the 'iron catalyst' source of positive ions of the alkalı and alkalıne earth metals. Its great advantage is that the mixture from which the ions are produced can be mounted on a filament and used in a high vacuum. The source is, moreover, steady and not readily exhausted, whereas most of the older methods of producing positive ions either required the presence of gas or gave an emission which fell off rapidly with time. Dr. Kunsman has been able to show that the temperature variation of both the positive ion current and the electron current from a given specimen is in accord with the Richardson

equation, and that the energy needed to remove a positive ion from the surface is consistently less than that required by an electron. It seems probable that metal diffuses to the surface in much the same way as thorium does in the heat treatment of a thoriated filament. The ions have been analysed at Princeton by means of the mass spectrograph and have been shown to be singly charged atoms, and they have already been applied in the same laboratory to the study of the secondary emission of electrons when metal plates which have been thoroughly freed from gas are bombarded with positive ions.

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THE BURNING OF CARBON DISULPHUDE.—It has been shown by A. G. White that the addition of small quantities of the vapours of ether, benzene, acetone, and acetaldehyde to mixtures of carbon disulphide and air causes a pronounced contraction in the range of flame propagation, especially at the lower limit. The results of further work on this subject are published in the Journal of the Chemical Society for April 1927. The present results are in general agreement with former work, and indicate that the added substance appears to act in three ways. (1) it alters the thermal constants of the mixture; (2) it alters the percentage of oxygen in the mixture, (3) it produces a specific catalytic effect. Of these, the catalytic effect is the most important and varies enormously from substance to substance. The order of efficacy of certain substances in preventing the propagation of flame at the limit in mixtures of carbon disulphide and air given by White differs from that found by Dixon.

DECOMPOSITION OF COAL.—Technical Paper No 16 on fuel research (London · H.M. Stationery Office. 9d. net) records observations by J. G. King and R. E. Willgress, of the Fuel Research Station, on the "Primary Decomposition of Coal" The temperatures of initial decomposition of fuels were found to range from 180° C. for peat to 215°-245° C. for bituminous coals. For these coals the temperature of initial decomposition appeared to increase with decrease in carbon content, and to increase with increasing oxygen The evolution of moisture is a gradual process, but the first acceleration of moisture evolution coincides with the appearance of oil vapour. The temperatures observed are somewhat lower than those recorded by previous workers, and deserve consideration in connexion with all processes or researches involving heat treatment of coal in the region of 200°-300° C., in which the possibility of chemical change must never be overlooked.

Dopes and Detonations.—The second report on dopes and detonations (Aeronautical Research Committee: Reports and Memoranda, No. 1062 (E 23). London: H.M. Stationery Office, 1927 1s. 3d. net) has recently been published. The investigation which the report describes has included an experimental and theoretical study of low temperature oxidation of liquid fuels in air, in conjunction with engine experiments to determine the relationship between detonation and observed chemical action. The conclusion drawn from the experiments is that detonation in paraffin fuels and ether is due to the accumulation of peroxides in the nuclear drops during rapid compression. These drops ignite simultaneously when the detonation temperature of the peroxide is reached. The amount of peroxide formed would not in itself be sufficient to cause the detonation observed, but acts as a primer by simultaneous ignition of the nuclear drops. The metallic dopes act by reducing the peroxides as fast as they can be formed, and preventing their accumulation, thus delaying the ignition of the drops.

'HAVEG'-In the Chemiker-Zeitung for May 11 there is an account of the use of 'Haveg,' an artificial resmous material like bakelite, for the manufacture of large pieces of chemical apparatus without the use of an iron-core or other reinforcement. Vessels can be constructed in one piece and without seams, up to 2.6 metres in diameter. The thickness of the walls varies from 10 mm. to 40 mm., and the vessels can withstand sudden alterations in temperature up to 130° C. Since the specific gravity lies between 16 and 18, the apparatus can be handled easily; more-over, breakages can be repaired inexpensively. During the hardening process the resin shrinks considerably, so that some difficulty is experienced during manufacture, if it is desired to combine it with metal. This difficulty has been overcome by constructing the inner vessel of perforated sheet metal, the perforations of which become filled with the resin, which when hard forms knobs or studs serving to bind the outer casing to the inner one.

RADIOLOGICAL APPARATUS — The latest (1927) edition of Messis Newton and Wright's catalogue of apparatus for radiology describes in a brief but quite adequate way the various types of apparatus they make for radio-diagnostic, radio-therapoutic and X-ray research purposes. The closed circuit transformer has been developed for many years by this firm, and they are now able to build these machines for 250 kilovolts rectified three-phase output, giving practically continuous high-tension current without the introduction of condensers. Considerable prominence is given among the illustrations to the types of 'Metalix' tubes which are now available for medical and other purposes. This tube is, we understand, becoming largely used in medical work, its handmess of form being a great feature in its favour.

ELECTRODE STEAM GENERATORS. The importance of having a uniform load on an electric power-station is well known to electrical engineers. If there is a large demand for a short period every day, the station must have sufficient plant to earry over the peak load, and this means that a number of machines are lying idle during nearly all the day, and so the overhead costs are large compared with the revenue Engineers do their utmost, therefore, to secure a level load. For example, they often supply energy at a much cheaper rate during the night when the demand is small. take advantage of this, electrode boilers are sometimes used which store the electrical energy delivered during the cheap period of supply as heat, either by heating water or converting it into steam. In the Bulletin for March of the Oerlikon Co. of Zurich, there is a description of electrode steam generators for electric pressures varying between 3000 volts and 8000 volts. One of the hospitals in Basle obtains steam and hot water for the kitchen and the laundry in this way. Two similar boilers each for 1000 kilowatt, 6000 volts, have been ordered for an installation in Great Britain. In Switzerland, where sometimes only a limited amount of electric power obtained from waterfalls is available, it is a boon to use these devices and so eliminate chimneys and smoke and avoid the necessity of coal storage room. The cost of maintenance of these electrode steam generators is very small. The equipment works as a star connected plant, with the boiler itself acting as the neutral point. It is therefore safe to have in a building. Tests on a hightension boiler for 1200 kilowatts and 6400 volts have shown that the efficiency of the boiler can be as high as 98 per cent. We think that these electrode steam generators can in many cases be advantageously

### The Influence of Water in Physical Change.

PROF H. E. ARMSTRONG has long insisted on the view that chemical action is a species of reversed electrolysis and that an electrolyte, generally water in terrestrial systems, is a sine qua non for chemical action. Whether we should regard modifications in the 'molecular' weights of a liquid, alteration in the constants' of the Van der Waal's equation of state for a vapour or gas, change in the surface tension or vapour pressure of a liquid, all due to association or dissociation, as caused by the operation of physical or chemical change, might be debated by

At least three different types of union can readily he recognised, such as the cluster of polar molecules round charged ions, the association of molecules which are either dipolar or possess poles of a higher order, and thirdly, the definite electrovalent bond in which one or more electrons have been definitely transferred from the orbit of one atom to another, chemical union is certainly not restricted to the third class. In the second there appear to be all graduations in strength of union between polar molecules with increasing mutual distortion of the valence electron orbits and consequent alteration in the electric moments of the molecules. The enoimous chemical reactivity of charged ions as well as the influence of water on chemical reactions indicates that water may function not only as an electrolyte but also in virtue of the fact that it consists of molecules of high

electric moment; the latter may promote, as observed

by Sir J. J Thomson, the formation of clusters or

addition compounds in reaction, and also render more

polar, and in consequence more reactive, the molecules

clustered in the primary addition compound

Similar conclusions as to the necessity of stages in compound formation may be drawn from a consideration of the phenomenon of adsorption as well as the energies of 'catalysed' and non-catalysed reactions. It is clear that such compound formation included in the term 'association' is not necessarily an electrolytic process as generally understood, for in at any rate simple systems it is no more than the clustering of polar molecules around an ion, and, in somewhat more complicated cases, the effect of mutual attraction of molecules possessing definite electric moments being either dipolar or polar of a higher order. Such considerations involve inclusion of both mutual and interaction of ions and of polar molecules each possessing finite electric moments, as well as of reactions

involving two electrodes and an electrolyte, in our system of chemical reaction mechanism

The delivery and publication of the presidential address to the Chemical Society on Mar. 24, by Prof H B. Baker, represents this further stage in the experimental development of the idea associated with the action of water in chemical change ("Experiments on Molecular Association." Jour Chem. Soc (April), 949; 1927). Since the president was one of the first to investigate experimentally the functions of water in chemical change in gas reactions, so it is only to be anticipated that he would be the first to investigate its functions in physico-chemical changes involved in molecular association

Prof Baker has shown that all the liquids which he has examined may be regarded as analogous to an associable gas such as introgen dioxide, association increasing with decrease in temperature. The position of equilibrium in liquids is thus influenced by alteration in temperature, and the rate of attainment of the new equilibrium is greatly affected by the presence of catalysts, of which water is one of the most important. The necessity for some type of catalyst is clear when the thermal energies involved are considered. Thus the mean thermal energy at 0° C of a molecule is some 0 035 volt, the process of disintegration of a binary complex of two hydrogen molecules requires only some 0 01 volt, but for vaporisation of liquids such as liquid bromine, benzene, or water, energies equivalent to 0.3 to 0.5 volt are required Hydrogen complexes evidently would be rapidly broken up by thermal agitation alone at ordinary temperatures, but the destruction of complexes in these liquids, although possible by thermal agitation, will evidently proceed at a slow rate in the absence of a catalyst necessarily polar in character.

The existence of such complexes in solution and the gradual transformation of one type into another has been amply demonstrated by Prof. Baker in numerous experiments which have been considerably extended in this address. He has shown, inter alia, by vapour pressure and surface tension measurements, that the rate of attainment of equilibrium is affected not only by water but also by solid catalysts such as charcoal, platinum black, and thoria. If these catalysts were actually as dry as the liquids employed, we note again further evidence in the process of adsorption for the operation of forces causing reaction in the absence of water.

Eric K. Rideal.

### Archæology in Greece.1

If this issue of the "Annual of the British School at Athens" belies its name by covering two yearly sessions, it is nevertheless true to its pre-War tradition both in the interest of its contents and the dignity of its appearance. First in importance must be placed the report of the excavations of two seasons, 1924 and 1925, at Sparta. In both years the main work was concentrated on the site of the theatre, where considerable portions of the stage and orchestra have been cleared and trials made in the cavea. This section of the work is described by the Director of the School, Mr. A. M. Woodward: the most interesting part of his description is that which deals with the scenae frons and the difficult problems connected with it. He shows that the cavea is a Roman construction, probably of Augustan age, doubtless on the site of an earlier and much smaller theatre. The evidence for

<sup>1</sup> "The Annual of the British School at Athens," No. 26, Sessions 1923-24, 1924-25. Pp. viii+392+22 plates (London: Macmillan and Co., Ltd., n.d.) 63s. net.

the date of the stage-buildings is less clear, for remains of several periods exist, the earliest of which may possibly be earlier than Augustus. The inscriptions from this site, fully published here by Mr. Woodward, are both long and important, for the marble facing-blocks of the east parados-wall of the theatre at its west end literally formed a single inscribed monument.

The other portion of the site attacked was the Acropolis, more particularly the area between the Hieron of Athena Chalkioikos and the retaining wall of the cavea of the theatre. Here a mixed deposit of various dates was cleared which yielded some of the best finds made during the excavations. The most important are the remains of a marble statue, slightly larger than life size, of a bearded warrior wearing a helmet with cheek-pieces decorated each with a ram's head. The arms are lost, but otherwise the statue is complete to the waist. The section in which Mr. Woodward dates this statue to about 480-470 B.C. and seeks to demonstrate that the subject is no other

than the hero of Thermopylæ, is among the most

interesting in the volume.

Messrs. Casson and Heurtley write on the excavations which the British School has for several years past been conducting in the mounds of Macedonia. The former describes a burnal mound at Chauchitsa with numerous interments of the iron age, beginning about 1150-1100 B.C., and the latter classifies and describes pottery picked up on mounds in western Macedonia and west Chalcidice.

It is a far cry from these prehistoric finds to the Finlay Library, some of the contents of which are described by William Miller in an article which is very attractive reading. The other contents of the volume well indicate how wide is the range of the School's activities and those of its students, past and present. Mr. Lawrence writes on Hellenistic sculpture from Rhodes, and Miss Lamb on stamped pithos fragments in the collection of the School, mostly from Melos. Mr. Tillyard discusses the difficult problem of the signature or Martyria in the Byzantine modes and its relation to the cadence; Mr. Seltman deals with the early cult of Eros in Athens and its representation in art, and Mr. Tod makes an invaluable contribution to Laconian epigraphy by giving a list (with references) of inscriptions omitted from the Corpus, or published since its appearance, and by supplementing its bibliographies.

### University and Educational Intelligence.

BIRMINGHAM.—The degree of D.Sc. in chemistry has been awarded to the following: John Alfred Valentine Butler, for numerous papers on "Studies in Heterogenous Equilibria"; and Harold Archibald Scarborough, for papers on "Saponification and Properties of Mixed Solvents."

LONDON.—Sir William Beveridge has been re-elected

vice-chancellor for the year 1927-28.

The title of emeritus professor of anatomy in the University has been conferred on Prof. Edward Barclay-Smith as from the end of the session 1926-27, when he retires from the University chair of anatomy

tenable at King's College.

The following doctorates have been conferred: D.Sc. in Chemistry on Mr. F. H. McDowall (University College), for a thesis entitled "Constituents of Myoporum lætum Forst (The 'Ngaio')"; Mr. I. R. McHaffie (University College), for a thesis entitled "The Effect of the Presence of an Indifferent Gas on the Concentration and Activity of a Vapour in Equilibrium with a condensed Phase or System of Condensed Phases"; Mr. S. O. Rawling (University College), for a thesis entitled "The Sensitivity of Photographic Emulsions"; and Mr. F. Tattersfield (Rothamsted Experimental Station), for a thesis entitled "The Relationship between the Chemical Constitution of Overenic Co Constitution of Organic Compounds and their Toxicity to Insects''; D.Sc. in Geology on Mr. S. W. Wooldridge (King's College), for a thesis entitled "Contributions to the Study of the Structure, Stratigraphy, and Geo-morphology of the London Basin"; D.Sc. (Engineering), on Mr. Bernard Hague (Imperial College—City and Guilds College), for a thesis entitled "Studies in the Theory of the Magnetic Field in Dynamo-Electric Machinery"; D.Sc. in Physics on Mr. J. W. T. Walsh, for a thesis entitled "The Theory of Luminescence in Radioactive Luminous Compound," and other papers.

A University postgraduate travelling studentship has been awarded to Dr. R. Purcell (Imperial College Science and Technology—Royal College of Science), who proposes to carry on chemical research at the University of Amsterdam under Prof. A. Smits, and to visit German universities.

The purchase for the sum of £525,000 of the Bloomsbury site by the University from the Duke of Bedford has been completed. The site, including roads, comprises about 111 acres, bounded by Montague Place, Malet Street, Gordon Square, Woburn Square, Upper Montague Street, and Russell Square. £400,000 has been provided by the donation from the Rockefeller Foundation and £125,000 is derived from a Special Government Grant in respect of improved accommodation for the University.

During the celebrations at Louvain on June 28 and 29 to commemorate the five hundredth anniversary of the foundation of the University, the honorary degree of D Sc. was conferred on Prof. E. G. Coker, professor of civil and mechanical engineering, University of London, University College.

A vacation course for open-air work in geography, regional survey, geology, botany, and sketching will be held in Snowdoma on Aug. 19—Sept. 2. The centre will be Llanberis, and excursions to selected parts of Snowdoma will provide training in all branches of open-air work. Further particulars may be obtained by sending a stamped addressed envelope to Mr. Valentine Davis, Cheshire County Training College, Crewe.

The Royal Commissioners for the Exhibition of 1851 have made the following appointments to Senior Studentships for 1927, the recommending bodies being indicated in brackets after the names. Mr. R. C. Blackie (University of Liverpool), for research in geology. Miss P. A. Hicks (University College of South Wales and Monmouthshire), for research in botany; Mr. R. Hill, for research in bio-chemistry, Mr. D. C. Rose, for research in physics, and Mr. L. H. Thomas, for research in theoretical physics (University of Cambridge); Dr E. J. Williams (University College of Swansea and the Victoria University of Manchester), for research in physics.

Post-War depreciation in the value of available funds has been keenly felt by those responsible for important libraries. The initial cost of books has largely increased, and the cost of binding has been more than doubled. Such expenditure, essential if the institution is to be up-to-date, presents therefore a difficult problem; and m a library such as that of University College, London (which ranks in point of size third among the libraries of London and fifth among the university libraries of the Empire), the problem takes on a very serious aspect. Already the University Grants Committee has indicated the inadequacy of present library provision (see also NATURE, May 21, p. 733). So insufficient are the available funds at University College that a capital fund of £24,000 is being sought. Without it the usefulness of the library will be seriously impaired, not only by lack of means for purchase and binding, but also because of the difficulty of printing subject catalogues and other aids which are almost indispensable to the scholar. It is to be noted, too, that £7000 was recently expended on structural alterations to the Science Library, which is also absorbing part of a special grant of £10,000 for its completion. While the libraries are arranged primarily to meet the needs of staff and students, it should not be forgotten that they are available for all genuine students who make application, and that members of the British Association and of the Geologists' Association, whose libraries form part of the Science Library, have the right to use that Library. All interested are invited to co-operate in providing the required sum of £24,000.

### Calendar of Discovery and Invention.

July 3, 1769.—Arkwright's famous patent for spinning by rollers was taken out on July 3, 1769, a few months after Watt's still more famous patent on the separate condenser for steam engines. A barber by trade, Arkwright became interested in the cotton-spinning problem in 1766 when thirty-five years of age, and his first machine was exhibited in the old Grammar School at Preston two years later His machine of 1769 is preserved in the Science Museum, South Kensington. There are four rollers in pairs, the top rollers being covered with leather, while the lower rollers are fluted, the several pairs being weighted to ensure contact. His roller drawing principle exists to-day.

July 4, 1840.—The first steam vessel to carry the mails between England and America, and the first vessel of the famous Cunard Steamship Company, the s.s. Britannia, sailed from Liverpool on her maiden voyage on July 4, 1840, and reached Boston in 14 days 8 hours. She was built of wood and driven by paddles, and could accommodate 115 passengers

July 5, 1639.—The incident related of Galileo watching the lamps swinging in Pisa Cathedral dates back to 1582. Many years afterwards, on July 5, 1639, in a letter he suggested the use of a swinging pendulum for astronomical purposes, and about the same time an arrangement was devised and set out on a drawing, for driving a pendulum by weights.

July 6, 1787.—On July 14, 1787, John Wilkinson, the famous Shropshire ironmaster, wrote: "Yesterday week my iron boat was launched. It answers all my expectations and it has convinced the unbelievers who were 999 in 1000. It will be a nine days' wonder, and then be like Columbus's egg." This iron canal barge, the first of all iron boats, was followed by several others, but iron as a constructive material did not come into general use for half a century.

July 7, 1879.—Among the most important observa-tories of the Far East are those of Zikawei, near Shanghai, and Manila, founded by the Society of Jesus, which alone among the great religious orders has been famous for its scientific work. The Manila observatory was first situated at Ateneo, and then at Ermita, and was founded in 1865 by Father Faura, S.J, who after some years of meteorological work, on July 7, 1879, predicted that a typhoon would pass The event justified his warning. over North Luzon This was the first time that the existence, duration, and course of a typhoon had been predicted in the Far East. Father Faura's subsequent work proved so valuable that the merchants subscribed for its continuance, and with the connexion of Manila and Hong Kong by submarine cable came the beginning of the system of weather forecasts which has proved such an immense boon to shipping in the China Seas.

July 8, 1814.—One of the visitors to Paris soon after the fall of Napoleon was Edward Stanley, Bishop of Norwich, who, writing to his wife on July 8, 1814, gave an interesting account of his visit to the Jardin des Plantes, where "everything is arranged in such order that it is almost impossible to see it without feeling a love of science; here the mineralogist, geologist, naturalist, and entomologist may each pursue his favourite studies unmolested. Here, as everywhere else, the utmost liberality is shown to all, but to Englishmen particularly, your country is your passport."

July 9, 1908.—Following up the methods of Sir James Dewar, Kamerlingh Onnes, of the University of Leyden, liquefied helium, the only remaining gas that had not been coerced into that state, on July 9, 1908.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, June 23.—J C McLennan and J. H. McLeod. On the wave-length of the green auroral line in the oxygen spectrum. In 1925, McLennan and Shrum found a line in the spectrum of highly purified oxygen of wave-length  $\lambda$  5577·35 $\pm$ 0·15, and provisionally identified it with the green auroral line. Reinvestigation with a Fabry-Perot interferometer now determines the wave-length of this line as 5577·341 $\pm$ 0 004 Babcock's value for the wavelength of the auroral line being 5577 350 $\pm$ 0·005, there would thus seem to be no doubt as to the identity of the lines. Apparently oxygen as well as introgen is present in those regions of the upper atmosphere whence the auroral light is transmitted.

A. Caress and E K. Rideal: The combination of introgen and hydrogen activated by electrons. A study of the combination of nitrogen and hydrogen to form ammonia in a triode valve has been made. Hydrogen atoms formed by thermal dissociation at a hot tungsten emitter combine with nitrogen at platmum and nickel surfaces to form ammonia. Hydrogen atoms excited by collision with ca 13-volt electrons react with molecular nitrogen in the gas phase to form ammonia. In the absence of hydrogen atoms (by using a mixed barium calcium oxide emitter) no ammonia is observed until a voltage of 17 volts is attained, and a further rise in rate of formation occurs at 23 volts. These two rises are attributed to the chemical reactivity of  $N_2^+$  and  $N^+$ . Ammonia seems to be produced by interaction of  $N_2^+$  and  $N^+$  with hydrogen to form primarily excited hydrogen atoms. The electron-efficiency of ammonia-formation from nitrogen ions is at least one ammonia molecule produced for the passage of four electrons; in the case of excited hydrogen atoms the efficiency appears to be even higher.

J. F. Lehmann and J. H. Osgood. The total ionisation due to the absorption in air of slow cathode Electrons ejected from a hot tungsten filament were accelerated to an anode, by a potential difference of 200 up to 1000 volts and a portion passed through a carbon capillary into an ionisation chamber. The electron current entering the chamber, and the positive ion current due to the absorption of these electrons, were measured alternately. Ratio of ionisation current to electron current gave average ionisation per electron. Using an electron beam of given initial energy, ionisation per electron is approximately proportional to pressure of absorbing air, provided this pressure was less than a certain 'critical pressure.' For greater pressures, ionisation per electron was constant. The magnitude of the critical pressure was determined by the initial energy of the electron beam. Ratio of ionisation current to electron current, at pressures greater than critical pressure, represents average total ionisation due to complete absorption of an electron. This is directly proportional to initial energy of electron, and the ratio, initial energy of electrons/average total ionisation per electron, gave average energy expenditure associated with the formation of a pair of ions. This average per ion pair was 45 electron-volts, whereas the ionisation potential of

air is 17 volts.

J. F. Lehmann. The absorption of slow cathode rays in various gases. A homogeneous beam of electrons of definite initial energy was introduced into an ionisation chamber. For complete absorption of the electron beam the average ionisation per electron was directly proportional to the energy of the electrons, the constant of proportionality varying markedly

from gas to gas. The ratio, initial energy of electron/ average ionisation per electron for complete absorption, determined the average energy expenditure associated with the formation of a pair of ions. This ranged from 31 electron-volts per ion pair in helium to 45 electron-volts per ion pair in air, nitrogen, and carbon dioxide. The efficiency of ionisation as defined by the ratio, ionisation potential/average energy expended per ion pair, was, in helium 0.78, argon 0.46, hydrogen 0 43, nitrogen 0 38, and carbon dioxide 0.32. Thus much of the initial energy of the electron was expended by processes other than separating the

molecule into positive and negative ion.

W. T. Astbury. A simple radioactive method for the photographic measurements of the integrated intensity of X-ray spectra. A simple photometric arrangement is described in which the negative is replaced by a carbon print and the measurements are carried out by means of α-rays and an α-ray electroscope. This radioactivity photometer has been applied to the investigation of the intensity distribution in X-ray crystal photographs. As a preliminary test the apparatus was used to find the intensity ratio,  $\operatorname{Cu} K_a/K_{\beta}$ . In X-ray photographs of the (muscovite) mica cleavage plane it was found that, 1st order  $\cdot$  2nd order  $\cdot$  3rd order  $= 66:31\cdot100$ , and that the intensity ratio is  $6\cdot 2$  The apparatus can give a curve showing a relation between X-ray intensity and α-ray intensity which is very approximately linear through

O. W. Richardson and F. S. Robertson. emission of soft X-rays by different elements. photoelectric activity of soft X-rays generated by electron impact on 14 different elements is measured. The soft X-ray yield under given conditions of electron excitation is a periodic function of the atomic member

of the anticathode element.

E. V. Appleton and J. Ratcliffe: On the nature of wireless signal variations (1). Two methods of measuring the angle of incidence of downcoming wireless waves, both involving photographic registration, are described. The first utilises the ordinary night-time signal variations and can be employed in connexion with any steady transmitting station. It only yields useful results if the natural signal variations are small. The second requires a controlled wave-length change at the transmitter, but may be used even when the natural signal variations are large. The mean values of the angle of incidence for the periods immediately following sunset and preceding sunrise show a close agreement, and lead to an effective height of 90-100 km. for the atmospheric deflecting layer. There is a diurnal variation in the height of the ionised layer: it is higher in the middle of the night than during the sunset and sunrise Comparatively rapid fluctuations have been observed in the angle of incidence of downcoming waves. Such fluctuations are considered as being due to 'reflection' at different points on a layer the mean height of which is sensibly constant.

E. V. Appleton and J Ratcliffe: On the nature of wireless signal variations (2). Experiments carried out on the nature of the variations of downcoming wireless waves responsible for nocturnal signal variations. A receiving assembly which is a combination of a loop and vertical aerial eliminates the effects of the ground waves at the receiving station. Large variations in intensity of downcoming waves are found. For wave-lengths of about 400 m. and distances of about 80 miles, fading is chiefly due to changes in the intensity of the downcoming waves. Variations in the phase relation between ground and sky waves are a secondary cause of fading. Changes m the angle of incidence or polarisation of the down-

coming wave are not responsible in any very marked degree for signal variations The downcoming rav has electric vectors both in, and at right angles to, the plane of propagation; similar intensity variations are found in both these vectors.

L H. Martin: The efficiency of K-series emission by K-ionised atoms. The K-series fluorescent radiations have been excited in plates of iron, nickel, copper, and zinc by beams of exciting X-rays ( $\lambda = 0.6$  $\stackrel{.}{A}\stackrel{.}{U}. \rightarrow K$  limits), and the efficiency of K emission determined by an ionisation method. The efficiency of K emission is also deduced for selenium, broinine, and rodine, from some early measurements by Barkla The following values have been found for the K-series quantum transformation coefficient, i.e. the number of quanta of K-series radiation emitted per K-ionised atom Fe (26) 0·29, Ni (28) 0·34, Cu (29) 0 40, Zn (30) 0 46, Se (34) 0 68, Br (35) 0 68, I (53) 0 88 The low values for this coefficient are explained in the hypothesis that in some conditions. as yet undetermined, the excited K radiation does not escape from the atom, but is 'internally absorbed' in the outer electron shells, giving rise to high-speed photo-electrons. It is found experimentally that the probability of K-series emission as opposed to its internal absorption is independent of the frequency of the exciting radiation. The K-quantum transformation coefficient is a function of atomic number, and such that it seems probable that sumlar laws, relating probability of absorption to atomic number and wave-length, hold in cases of 'normal' and internal 'absorption.

Geological Society, May 25.-F S. Wallis: The Old Red Sandstone of the Bristol district. Although the total thickness of these deposits is now estimated at 3000 feet, the faunal contents give evidence of the presence of bods of Upper Old Red Sandstone age only, and no apparent unconformity in the strata or mineralogical break has been detected. Every gradation of deposit between the following types can be found: Coarse- and time-grained samples, cornglomeratic sandstones, siltstones, quartzites, cornglomerates. True found: Coarse- and fine-gramed sandstones, constones, pure limestones, and conglomerates. marks and shales are absent. The material was derived from a pre-Cambrian massif consisting of gneisses, mica- and quartz-schists with abundant quartz augen and volcanic or intrusive rocks, together with a sedimentary series of arenaceous and calcareous (largely silicified) types. This source was situated north-west of Bristol, and its rocks were similar to those of the Mona Complex, and especially to the Gwna Beds of that formation It is not, however, necessary to postulate that the material came from the Anglesey of the present day. The sediments were transported by a great river, which, flowing through a country affected by heavy seasonal or spasmodic rainfalls, finally reached the sea by a broad delta m the neighbourhood of the Bristol district. Lagoons also formed important physiographical features near the coast

#### SHEFFIELD.

Society of Glass Technology, May 18.-G W. Morey and N. L. Bowen: The decomposition of glass by water at high temperatures and pressures. glasses were heated with water in steel bombs for about 20 hours. The bomb was then cooled and the product examined. For optical glasses the amount of attack was greatest with a light barrum crown, and least with the very dense barium crowns, which were remarkably resistant. Of commercial glasses, Jona combustion tubing withstood the action of water best, whilst the failure of Pyrex glass was outstanding.

At lower temperatures Pyrex glass was exceedingly good, but at the higher temperatures of the experiments the boric oxide was completely extracted. The crystals obtained with Pyrex glass at 325° C. were unknown.—G. Gehlhoff and M. Thomas: The brittleness of opal glass. A dense opal glass containing much fluorine was used, the opacity being increased by the addition of zinc oxide. At a temperature of about 1040° C. discontinuous changes take place At high temperatures the glass is clear; in cooling down, crystals of a uniform and small size of grain are precipitated. The glass kept below the devitrification temperature already contains (owing to its having stood longer) bigger crystals. On further cooling down, in conformity with the law of the yet undefined constitution diagram, small crystals are precipitated, whereas the existing big ones still grew. Thus opal glasses must necessarily be worked above the temperature where precipitation of crystals causes opacity brittleness results if they are worked below that temperature.—Francis Redfern, jun. British 15-arm automatic suction bottle machine There are approximately 40 tons of moving parts mounted on the stationary element and the whole machine weighs about 60 tons It will revolve up to speeds of between 6 and 7 revolutions a minute, and is electrically controlled. A week's production of merchantable reputed quart bottles is estimated at 2800 gross. The machine can be produced in three sizes, 6 units, 10 units, and 15 units.

#### PARIS.

Academy of Sciences, May 23 .- A. Lacroix: The meteoric iron of the oasis of Tamentit in the Tociat. This meteorite has been removed to Paris. Its date of fall was about 1400, and it is of interest as being the oldest meteoric iron known. It is poor in nickel and belongs structurally to the ataxite group.—L. Lecornu: The equipartition of energy —C Sauvageau The gametophyte of Nercia filiformis —Charles Nicolle and Charles Anderson The comparative study of some recurrent virus, pathogenic to man.—Gaston Julia A class of polynomials—G. Cerf: A property of invariance of the group of contact transformations and the transformations of certain partial differential equations of the second order with n independent variables.—Corps A new explanation of the negative result of the Michelson-Morley experiment .-W. Arkadiew: Sounds due to the magnetisation of iron.—C. Gutton and Mme. J. Mihul The permeability of iron at high frequencies. The experiments described lead to conclusions in agreement with those of Laville. For wave-lengths varying between 8 and 25 metres, no variations in the permeability of iron could be proved analogous to the variations of the dielectric constant in the neighbourhood of absorption bands.—P. Bovis: Absorption spectra and pleochroism of iodine and of herepathite. Solid iodine possesses a large absorption band with maximum density at wave-length  $0.255\,\mu$ —E. Darmois: The rotatory power of the tartaric ion. A study of the effects of the presence of neutral salts in the tartrate solutions on the rotatory power. In these solutions sodium tartrate undergoes varied modifications in rotatory power both the magnitude and sign of  $[\alpha]$ are changed If it is assumed that these modifications are of a physical nature, it would appear to be very improbable that a single explanation can cover all the cases.—R. de Mallemann: The calculation of the rotatory power of a system of molecules or anisotropic atoms Application to quartz.—Mlle. C. Chamié: The grouping of atoms of radioactive elements in mercury. In mercury the radioactive sub-

stances examined (radium, thorium, actinium, polenium) do not appear to dissociate into individual atoms, but are distributed into small groups of atoms, which show by their photographic effect the a-particles they emit —P Maurice Vèzes The calculation of ionic equilibria —Mlle. Germaine Cauquil Viscosity and geometrical isomerism Derivatives of cyclopentanol and cyclohexanol have been examined from the point of view of the viscosity of the cis and trans isomers and the latter have been found to possess higher viscosities than the former Similar differences would appear to exist in the cis and trans dichlorethylenes but the increase is not so marked. J. Cournot and E. Perot Some special cementations of aluminium and of duralmin after a double electrolytic Researches made from the point of view of the protection of aluminium and light alloys from the corrosive action of sea water -Mme. Ramart-Lucas and M Fasal: Contribution to the study of The 5-methyl-3.3-dialkylpyrrolithe pyrrolidones dones, treated with sodium amide and alkyl halide, react in the lactam form and give N-alkyl derivatives—J Bougault: An example of other-oxide of a ketone hydrate Benzalphenylethylsuccinic and benzylphenylethylmaleic acids.—R. Cornubert Study of the action of sodium amide on cyclohexanone.-F. Blondel. The geological nature of the south-east of Indo-China—E. Bruet The discovery of the upper Pliocene in the valley of Aujon.—Jean Piveteau: Some fossil fishes from the north of Madagascar. One of the specimens collected by Waterlot in the Ambibole region belongs to the genus Acentrophorus, previously only found in the upper Permian in England. A discussion of the Madagascar form shows it to approach the species A. varians and A. glaphyrus — Em. Perrot and Raymond-Hamet: The Yagé, a plant used as a stimulant by the Indians of the Amazon region of the equator and of Colombia. The plant appears to be Banisteria Caapı, and the active principle is an alkaloid, telepathine The poisonous dose for animals (pigeon, guinea-pig, dog) is 200 mgm. per kilogram, and its local anaethetic action resembles that of cocame.—Louis Léger. The nature and evolution of the 'spherules' described in Ichthyophonus, a parasite of the trout. - Huguenard and A. Magnan An accelerograph permitting the direct measurement of the accelerations of a bird in flight. -M. and Mme A. Chauchard: Quantitative researches on the excitability of the apparatus of taste in man.—Jean Roche and Mme. Eugénic Siegler-Soru: The respiration in vitro of the blood of various homeotherm animals—Mile. M. L. Verrier. The transitory cephalic organs of the fry of Acara tetramerus—Jules Barrois: The medusoid stage of Velleles.
—Stelys: The physiological origin of cancer. The
geophysics of a pathogenic medium. Outline of a universal causality.

### GENEVA.

Society of Physics and Natural History, April 21.—L. Duparc: The tectonic of the Tonkin coal basin. The strata of this basin, hitherto generally attributed to the Devonian, are Permo-Triassic. From this follow important modifications of the tectonic interpretations of this basin, the coal of which, sometimes in very thick seams, is of Triassic age.—W. H. Schopfer: The refractive index of the cysticeric fluid and its variations. This index is 1.3358 for the internal fluid and 1.3430 for the external fluid. This index gives interesting indications on the approximate content of the fluid in proteins.—G. Tiercy: The effective temperatures of the giant stars. Applying the formula of Saha corrected for the constant, the

author obtains for the stars of the spectral type M<sub>0</sub>,

 $K_5$ ,  $G_5$ ,  $F_5$ ,  $A_5$ ,  $B_5$ : Giant stars:  $M_0$  2200°,  $K_5$  2900°,  $G_5$  3800°,  $F_5$  5600°,

 $A_5 9200^{\circ}$ . Dwarf stars: M 4000°,  $K_5 4300^{\circ}$ ,  $G_5 6500^{\circ}$ ,  $F_5 8500^{\circ}$ ,

## Official Publications Received.

Department of Zoology, University College of Wales, Aberystwyth Report on Marine and Fresh Water Investigations (New Series 2, Years ending 30th June 1924, and 50th June 1925) 1 p 70 (Aberystwyth

Report on Manne and Fresh Water Investigations (New Seines 2, Years ending 36th June 1924, and 56th June 1925) 1 p. 76 (Aberystwyth 5s.

Southern Rhodesia. Report of the Director, Geological Survey, for the Year 1926 Pp. 11 (Salisbury Government Printer)

Proceedings of the Society for Psychical Research Part 102, Vol. 36, June Pp. 437-513 (London Francis Edwards.) 4s. 6d. net.

Hull Museum Publications. No. 124 Wilberforce House, its History and Collections. By T. Sheppard. Newedition Pp. SS+30 plates. 1s.

No. 148 Record of Additions Edited by T. Sheppard Pp. 184-5 plates. No. 149 Volkshire Silver Tokens, etc., in the Hull Museum By T. Sheppard Pp. 22. (Hull)

The Journal of the Central Bureau for Animal Husbandry and Dairying in India. Vol. 1, Part. 1, April. Pp. vi+59+5 plates. (Calciuta Government of India Central Publication Branch.) 10 anima.

Aeronautical Research Committee Reports and Memorianda. No. 1065 (Ac. 247): Preliminary Experiments on Two-Dimensional Flow round Bodies moving through a Stationary Fluid. By Prof. B. Melvill Jones, W. S. Farren and Flight-Lieut. C. E. W. Lockyer. (A. 1.b. Photographic Work, etc. 11.—T. 2350.) Pp. 12+15 plates. (London: H.M. Stationery Office.) 1s. 6d. net.

Gypsy Lore Society Monographs. No. 4. The Position of Romani in Indo-Aryan. By Prof. R. L. Turner. Pp. 47. (London: Bernard Quaritch, Ltd.)

Transactions of the Royal Society of Edinburgh. Vol. 55, Part. 2, No. 14: The Igneous and Metamorphic History of Cromar, Deeside, Aberdenshire By Dr. H. H. Read. Pp. 317 353. (Edinburgh Robert Grant and Son., London. Williams and Norgate, Ltd.) 4s. 6d.

British Museum (Natural History). Picture Postcards. Set C20. British Museum (Natural History). Proceedings of the Geologists. Association. Edited by A. K. Wells. Vol. 38, Part. 2, June 21st. Pp. 145 263. (London: Edward Stanford, Ltd.). 5s. Part. 2, No. 140 5s.

Diamond Jubilee of the Confederation of Canada: Sixty Years of Canalian Progress, 1867-1927. Pp. vnr.+168. (London. High Commissioner for Canada.) 10 cents.

#### FOREIGN.

Geofysiske Publikasjoner utgitt av det Norske Videnskaps-Akademii Oslo. Vol 5, No. 2: Photogrammetrische Bestimmung der Hobe von risierenden Wolken (Perlmuttet wolken) am 30 Dezember 1926 Von Carl Stormer. Pp 8+2 Tafeln. (Oslo: A W Broggers Boktrykkeri A/S) 1.50 kr.

Treasury Department. United States Coast Guard Bulletin No 15: International Ice Observation and Ice Patrol Service in the North Atlantic Ocean, Season of 1926. Pp v+127. (Washington, D.C.: Government Printing Office.)

Report on Norwegian Fishery and Marine Investigations. Vol 3, No. 8: The Production of Plankton in the Coastal Waters off Bergen, March-April 1922 By H. H. Gran. Pp 74. (Bergen. A. S. John Gliegs Boktrykkeri)

Department of the Interior Burgan of Education. Palette 1955.

Department of the Interior Bureau of Education. Bulletin, 1927, No. 10. Educational Boards and Foundations, 1924-26. By Henry R Evans. Pp. 12. (Washington, D.C. Government Printing Office) 5

Evans. Pp. 12. (Washington, D.C. Government Printing Office) 5 cents

Smithsonian Miscellaneous Collections. Vol 78, No 8: The Flora of Barro Colorado Island, Panama. By Paul G. Standley (Publication 2914) Pp 32. (Washington, D.C.: Smithsonian Institution)

Publikationer fra det Danske Meteorologiske Institut. Meddelelser, No 7: Meteorological Problems n: The Energy of the Winds By V. H. Ryd. Pp. v4-96 (Kjøbenhavn G. E. O. Gad.)

Stanford University Publications. University Series, Biological Sciences, Vol. 5, No. 1. Introduction to the Liminology of the Sears-ville Lake. By Dr. Flora Murray Scott Pp 33. (Stanford University, Calif., Stanford University Press.) 1.50 dollars

Contributions from the Dudley Herbanium of Stanford University, Vol. 1, No. 1: A Distributional Catalogue of the Liupines of Oregon. By Charles Piper Smith. Pp 55. (Stanford University, Calif.: Stanford University Press.)

Bulletin of the Terrestrial Electric Observatory of Fernando Sanford, Palo Alto, California, Vol. 3 Summary of Observations on Earth Potenbual, Air-Potential Gradients, and Earth-Currents for the Year 1925. Pp 24. (Palo Alto, Calif.)

Field Museum of Natural History Anthropological Series, Vol. 17, No. 1: A Correlation of the Mayan and European Calendars. By J. Catalogue of Birds of the Americas and the adjacent Islands in Field Museum of Natural History. Initiated by Charles B Cory, continued by Charles E Hellmayr Part 5 Tyrrandae. (Publication 242.) Pp v1+517. Anthropology, Memoris, Vol. 2, No. 1: Archaeological Explorations in Peru Part 1. Ancient Pottery from Trujillo. By Prof. A L Kroeber. (First Captain Marshall Field Archaeological Explorations in Peru Part 1. Ancient Pottery from Trujillo. By Prof. A L Kroeber. (First Captain Marshall Field Archaeological Explorations in Peru Part 1. Ancient Pottery from Trujillo. By Prof. A L Poten.) Pp 48-143 Plates (Chicago, Ill.)

Iova Geological Survey. Vol. 31. Annual Reports, 1923 and 1924, with accompanying Papers. Pp 400. (Des Moines, Iowa.)

United States Department of Agriculture. Department Bulletin No. 1487 A Study in Hyperparasitism, with particular reference to the Parasites of Apanteles melanocclus (Ratzeburg) By C F W Mussebeck and S M Dohaman. Pp. 36 (Washington, D.C.: Government Printing Office) 10 cents

#### CATALOGIES

Constable Books, 1927. (Summer edition) Pp 24. (London Constable and Co, Ltd.)
Important Works on Natural History and Science, published prior to 1800 (Catalogue 150.) Pp. 41 (London: Dulau and Co, Ltd.)
Fine and Applied Arts, First editions, Modern Presses (No 437)
Pp. 20 (Cambridge Bowes and Bowes)

### Diary of Societies.

#### SATURDAY, JULY 2.

SATURDAY, July 2.

Institution of Municipal and County Engineers (North-Western District Meeting) (at Town Hall, St. Anne's on Sea), at 10.30 am Physiological Laboratory, Oxford), at 1—F Buchanan A Method for recording the Action-Chitich of a Single Spot of Skeletal Muscle without injuring any other Spot —F R. Fraser, J B S Haldane, R Hilton, and G C Linder A Study of the Artenia Blood in Ammonium Chloride Acidosis —Dr E. D Adrian and Rachel Matthews. The Interaction of Rebinal Neurones—Prot. J Mellanby The Digestion and Absorption of Fat —Demonstrations —Apparatus for investigating Radiant Heating and its Effects, by Prot II M Vernon and M D Vernon.—Some Changes in the Tissues during Attempted Acclimatisation to Alterations in Og-Pressure in the Ari, by J A Campbell.—Method of studying Chiated Epithelium of Trachea, by Di Leonard Hill
Royal Society of Medicine (Disease in Children Section) (Provincial Meeting at Royal Alexandra Hospital for Sick Children, Dyke Road, Brighton)

Brighton)

#### MONDAY, JULY 4.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Sir Joseph Larmor The Grasp of Mind on Nature. The James Scott Prize will be presented to Sir Joseph Larmor

ROYAL INSTITUTION, at 5.—General Meeting.
SOCIETY OF CHEMICAL INDUSTRY (Annual General Meeting) (in Edin burgh).

#### TUESDAY, JULY 5.

ROYAL SOCIETY OF MEDICINE, at 5 —Annual General Meeting. SOCIETY OF CHEMICAL INDUSTRY (Annual General Meeting) (in Edinburgh)

#### WEDNESDAY, JULY 6.

SOCIETY OF CHEMICAL INDUSTRY (Annual General Meeting) (in Edinburgh).

#### THURSDAY, JULY 7.

SOCIETY OF CHEMICAL INDUSTRY (Annual General Meeting) (in Edin-burgh).

#### FRIDAY, JULY 8.

SOCIETY OF CHEMICAL INDUSTRY (Annual General Meeting) (in Edinburgh)

#### SATURDAY, JULY 9.

SATURDAY, July 9.

British Mycological Soulety (Phytopathological Meeting) (at the Research Station, East Malling, Kent), at 11.30—R. G. Hatton: General Account of the Station and its Activities.—At 12.—Demonstration of Reversion in Black Cultiants, by Mr Hatton and Mr. Amos.—At 130—Dr. H. Wolmald. Brief Outline of the Pathological Problems under Investigation at East Malling.—145 to 345—Tour of Egham Field and Great East Field, and Examination of Specimens, Cultures, etc., in the Laboratory. Fratures of pathological interest include examples of 'Die back' in Plum Trees, various Raspberry Discases, Walnut Bacteriosis, Spraying Experiments against Raspberry Anthracaose, and Apple Spraying Experiments, etc.—At 430—General Discussion.

#### CONFERENCE.

#### JUNE 30 TO JULY 2

NATIONAL ASSOCIATION FOR THE PREVENTION OF THREEGULOSIS (at British Medical Association House, Tavistock Square, W.C.1)

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No. 3010, Vol. 120]

# Science in Non-Self-Governing Dependencies.

OVERNORS and other official representatives of the non-self-governing dependencies of the Crown, recently gathered together at the Colonial Office Conference, devoted no little attention to a consideration of the function of scientific research in the development of the territories for which they are responsible, and the means by which this research is to be promoted. The outcome of their deliberations is the report on Colonial Scientific and Research Services which they approved and adopted on May 27, and is now available to the public in the published proceedings of the conference—the first of its kind.

From the point of view of research, no more favourable time could have been chosen for this first conference. It has followed closely upon the visit of the Parliamentary Commission to East Africa in the latter part of 1924, the personal visit of the Under-Secretary of State for the Colonies to West Africa in 1926, the tour of Mr. Roy Wilson and Mr. Harry Snell to British Guiana this year, and the reports which were presented to Parliament at their conclusion, in all of which the dependence of economic development upon the creation of new knowledge and the application of existing scientific and technical knowledge was emphasised. Furthermore, it is only a few months since the Premiers and other representatives of the self-governing Dominions met, and were led to consider similar problems and approved a report of a sub-committee which they appointed on Empire research.

The changed attitude of the Dominion premiers towards scientific research as manifested in that report was the subject of comment in these columns at the time. At the Imperial Conference in 1923 they sought for a solution of their economic problems in political expedients; three years later they decided to give science a trial. Upon this result the present political heads of the Colonial Office can be congratulated, for they have assiduously preached the gospel of science for the past two years.

Under influence of the same stimulus, the representatives of the non-self-governing dependencies have reacted in the same way as the Dominion representatives. One of their first acts in conference was to appoint a committee under the chairmanship of Lord Lovat "to frame and submit a scheme, based on contributions to a common pool, for the creation of a Colonial Scientific and Research Service available for the requirements of the whole

Colonial Empire, for the support of institutions required for that purpose, and for the increase of research and study facilities in connexion with the specialist services of the Colonics generally."

In the general statement of the problem the Committee has drawn largely upon the information contained in the report of the Committee on Agricultural Research and Administration in the Non-Self-Governing Dependencies, of which Lord Lovat was also chairman. Its recommendations are almost identical with those put forward in that report, and follow the general principles enunciated in the report of the East Africa Parliamentary Commission for the effective prosecution and coordination of research. The modesty of its proposals, however, will be gauged from the fact that the scheme proposed for the reorganisation of the colonial agricultural services involves an annual expenditure of £175,000 in all, a considerable proportion of which is at present a charge on colonial revenues. This is a very small sum when regarded from the point of view of the needs of colonies covering a total area of roughly 2,000,000 square miles, the populations of which-mainly agricultural—number 50,000,000, controlled by thirty distinct administrations. It is illuminating to relate the cost of such a service to the exports from the colonies to the United Kingdom. These exports, mainly agricultural, have quadrupled in the last twenty years and amounted to £81,000,000 in 1925. In that year "they were greater than those from the whole of India, or from any single one of the self-governing Dominions." If the total agricultural exports of the colonials are taken into account, including rubber, the cost of the proposed service works out to 1 of a penny in the pound. The Committee states that so far "the aid of science has been but half-heartedly invoked," but it is difficult to see how this state of affairs is to be remedied with such meagre financial provision.

The committee is well aware of the needs of research. It appreciates the fact that "there is severe and growing competition between the sources of raw materials and food-stuffs for the supply of the world's markets"; that "the ravages of diseases, particularly among the luxuriant conditions of tropical life, are ever increasing"; and that "science, and science alone, can enable us to increase production by improved methods, and, at the same time, combat successfully the diseases which these new methods bring in their train." It notes that the "United States, the area of which is one-third larger, and the population a little more than double that of our

Colonial Empire, spends more than £4,000,0000 annually on agricultural research"; and that Egypt spends nearly twice as much annually on agricultural entomology as the whole of the British colonial governments, most of which are faced with far graver problems than Egypt. Unfortunately, the committee gives no indication of the expenditure of France, Belgium, or Holland on agricultural research in their respective colonies; but we know that the Dutch maintain Buitenzorg splendidly while the Amani Institute is still lying derelict, untenanted, unstaffed; we know that the French are devoting much attention to the investigation of nagana (tsetse-fly disease in cattle), and are attempting to breed immune types, while we continue to starve the veterinary research stations in East Africa, and to expect the research staffs to devote a considerable proportion of their time to the preparation of sera for inoculating cattle against the various diseases which decimate the natives' herds.

In view of the condition of affairs regarding research and research institutions and the scientific services generally, as disclosed in the various reports to which we have referred above, in fact, to the complacent indifference to science which characterises our colonial administration, and the statement of Lord Lovat's Committee that "there is no organisation whatsoever in the colonies which views the problems of science as a whole," we can but admire the forbearance of the committee in stating that it is anxious not to give the impression that it is trying to be dietatorial to the colonial governments. It is well, however, that it has obtained general consent to the establishment of a central fund maintained by contributions from the various colonies. This should ensure continuity of research, and safeguard the individual scientific officer against the excessive zeal of colonial governments to reduce their scientific staffs in times of financial stringency. The evident purpose of the committee's recommendations is to make the research services of the colonies attractive to the best type of worker, and this is certainly a greatstep forward.

The committee felt itself unequal to the task, in the short time available, of formulating proposals for the creation of a unified research service, postulating as it does modifications in the organisations (existing and proposed), the creation of links between various sciences not only in the colonies but also through research organisations at home and in the Dominions That task is left for another committee, which will have the advantage of making

fronting them.

The Lovat Committee, however, is quite definite as regards the organisation of a colonial agricultural research service. It recommends that a central council should be constituted with a chairman (who should be a layman), a director (who should be a recognised man of science), and a deputydirector (who should have had administrative experience in the tropics). The formal channel of communication between the council and the Secretary of State should be through the chairman. The members of the Council should be the directors of the Royal Botanic Gardens at Kew, of the Imperial Bureau of Entomology, and of the Imperial Bureau of Mycology, a chemist, and representatives of veterinary science, of the Imperiaf Institute, of the Colonial Office, and of the Empire Marketing Board. Liaison with the Medical Research Committee and any other research committee should be maintained either by co-opting a member of that committee as occasion required, or by creating an ad hoc committee of members of the bodies concerned to deal with borderline questions.

The proposed constitution of the council is open to criticism. No reasons are given for the choice of chairman. What precisely is meant by a layman? Is he to be a man whose impartiality and sound judgment are to be guaranteed by his complete ignorance of science ? Exception might be taken also to the selection of the scientific representatives. Presumably botany, mycology, entomology, and chemistry are regarded by the committee as the four sciences of most importance to agriculture. Two of them are mainly concerned with the pathological aspects of agricultural research, admittedly of importance, but certainly not so important as research in genetics aiming at the production of new varieties of plant and animal types resistant to disease. At least one geneticist should be added to the council. The claims of physicists to representation on the council are also strong. A physicist would be able to advise on most problems in connexion with the relationship of soil and climate to plant life as well as those concerned with the transport and storage of agricultural produce. If there is a fear that the council would be too unwieldy, the substitution of an agriculturist—say the director of Rothamsted Experimental Station—for the four scientific members proposed by the committee, would preserve its balance and not diminish its effectiveness as a council. Perhaps it is not too late, also, to suggest that an ex-member of the Indian agricultural services should be given a seat on the Many of the difficulties which beset agriculturists in the colonies are identical with those which have already been successfully surmounted in India by the application of research, and it would be well for the council to have the advice of some one thoroughly familiar with the methods already successfully adopted there. A further point might also be considered. The principle of automatic retirement of members of advisory councils after a short term of years has already been applied to membership of the Medical Research Council and the Advisory Council for Scientific and Industrial Research. If the Colonial Agricultural Research Council is constituted as proposed, this principle could not be applied.

The observations of the committee on the need for attracting the best talent to the colonial agricultural services will commend themselves to scientific workers as a whole. It must provide a career. "It must be well paid, and the financial prospects held out must be better than those which obtain at present." An officer entering the unified service must be liable to transfer, but he must be safeguarded against any loss on transfer recommended that retiring benefits for the members of this service should be provided by a provident fund scheme Transfers of research officers to the administrative side of agriculture would not then present any difficulties in this regard. Before the recommendations of the conference can be translated into facts, however, the committee which has just been appointed by the Secretary of State for the Colonies has to go fully into the question of finance and submit its proposals to the colonial governments. This procedure involves vexatious delay and might have been obviated

The tentative proposals of the committee on the unification of the various colonial research services need not be considered at this juncture. It will be time enough to deal with the matter when it is made the subject of a report by the further committee which is to be set up. The progress made in connexion with the agricultural research services will be studied with interest, and once the recommendation of the conference is made operative, that the poorer colonies will be entitled to command the services of first-class men from the central pool—equally with those, colonies with greater financial resources—provided their problems are of sufficient importance, no excuse will remain for their starving these essential services.

## The Gentle Art of Chemical Controversy.

Essays on the Art and Principles of Chemistry: including the First Messel Memorial Lecture. By Prof. Henry E. Armstrong. Pp. xxxi+276 (London: Ernest Benn, Ltd., 1927.) 15s. net.

WHILE we regard parts of this book as beneath the dignity of the science the art and the principles of which it professes to expound, we cannot repress some feeling of sympathy with the author for the courage he shows in resisting superior forces. We can admire Prof Armstrong's defence of the name of 'oxygen,' we can appreciate his insistence that water acts chemically when dissolving salts. but is anything gained by crude lampoons on van't Hoff, Arrhenius, and Ostwald—and indeed on the whole school of modern physical chemistry founded on their work <sup>2</sup>

The motif of the book appears to be that chemists are not only a perverse and unthinking crowd, easily hypnotised by any 'Nordie' magician who can work the spell of the integral calculus, but also, having been inoculated with the ionic virus, are unable to see the clear facts which Prof. Armstrong has been putting before their eyes for the last forty years. Why should this be? Probably the force of prejudice and of dictated belief has blinded them: they have not understood. The case must be presented again in a more comprehensive and definite way.

The root of the trouble is twofold: people have never grasped that water is not the simple, neutral, self-satisfied body made up of an oxygen atom holding a hydrogen atom in each of its two hands—it is a far more complicated affair, a mixture of 'polyhydrones' of various orders of complexity holding in solution simple 'hydrones' (H<sub>2</sub>O), the capture of which by molecules of dissolved salt or acid alters the physical properties of the solvent; and, secondly, no chemical action can take place unless there is a tertium quid—usually conducting water—to form an electrolytic system through which the change occurs.

The year 1885 must still be sodden with the tears of things. In that year Prof. Armstrong first preached the true doctrine to the Chemical Section of the British Association; in that year the conception of the dissociation of salts in dilute solution became known—to use Prof. Armstrong's phrase, "Arrhenius came forward as a Whole-Hogger"; and "in 1885 van't Hoff, assuming the character of the Hatter, invited us to a scientific Mad Tea Party, at which he out-hatted the Hatter." But even this combination of 'genius' and 'youthful

enthusiasm' would not have prevailed alone to spread the 'joke'; it was carried far and wide by "floods of Ostwaldian ink." Is not this language a little reminiscent of a celebrated criticism of the Hallucinations and the 'Phantasiespiclereien' of a certain Dr. J. H. van't Hoff, and does not our modern Censor rather out-Kolbe Kolbe?

Chemists can understand the protest against the idea that water, acting as a solvent, is a mere material vacuum-chamber affording room for the salt to dissociate; they can believe it is an active chemical substance, and that the action between salt and water is reciprocal. Here is a strong position to hold, but Prof. Armstrong is not content to hold it. The salt, or the acid, cannot react with water without an intervening electrolyte. "Take," he says, "pure non-conducting water and pure non-conducting hydrogen chloride: they cannot react chemically, but they can form a couple by some mechanical 'attraction' or process of 'dis-This couple (being an electrolyte?) tribution.' can now bring about union between it and another pair of molecules to form a complex which splits up into two bodies—one, 'muriated hydrol,' the other, 'hydrone chloride.'" We are given a picture of the process, which we partly reproduce:

So far the conception seems clear, but afterwards it is harder to follow. The two hydrogen chloride molecules have each incorporated a volatile hydrone molecule, and by so doing have altered the physical properties of the solvent; but one has to account for each molecule of hydrogen chloride producing double the effect of a neutral non-conducting molecule. It seemed at first sight that Prof. Armstrong considered the 'hydrone chloride' molecule to be more readily acted on by hydrone than its sister hydrol, and we pictured a further process taking place:

$$H_{2}O + OH = H_{2}O + HCI$$

$$H_{2}O + OH = H_{2}O + HCI$$

$$H_{2}O + OH = H_{2}O + HCI$$

$$H_{2}O + HCI$$

$$H_{3}OH = H_{2}O + HCI$$

The hydrogen chloride liberated in the last equation would presumably repeat the cycle, so that finally for every HCl molecule dissolved, one hydrone would be captured and held bound as 'muriated hydrol,' while two hydrones would be incorporated as hydronol which is represented as a stable molecule. That this is the interpretation meant by Prof. Armstrong seemed confirmed by his statement (p. 266) that the osmotic activity is to be attributed, in a dilute solution of hydrogen chloride, to the molecules of muriated hydrol and of hydronol. It will be noticed that in this interpretation every HCl molecule dissolved affects three, and not two, hydronic molecules. but in the equation suggested on page 264 to account for the production of hydronol both the hydrone chloride and the muriated hydrol react with hydrone and all the hydrogen chloride is liberated:

If the two HCl molecules liberated in this equation are free they would, presumably, repeat the original cycle until *all* the free hydrone was converted into 'hydronol' But if they form the

H complex ClH (labelled d on p. 263) and this is

unacted on by hydrone, then each HCl molecule has only anchored one hydrone.

Probably Prof. Armstrong can devise some way out of the difficulty which eludes us, or possibly we have been caught by a snag somewhere. When a man prides himself on his clear and forcible English, what are we to make of the following statements? On page 266 he writes: "This osmotic activity is to be attributed. . in a dilute solution of hydrogen chloride, for example, to the molecules of muriated hydrol and of hydronol,

he says. "As the concentration is lowered, under

the influence of hydrone, the complex RX OH

is more and more converted into hydronol. Ultimately the solution contains the solute only in the

 $\operatorname{form} H_2O$  together with an equal number

of molecules of hydronol." The difficulties of No. 3010, Vol. 120]

following the hypothesis of electrolytic dissociation seem small in comparison.

Similarly in all cases of oxidation, whether it be a solid or a gaseous fuel that is burnt, hydrone is the sine qua non. Take that peculiar gas carbonic oxide. "It is commonly recognised," Prof. Armstrong writes, "that this gas cannot be burnt dry, but that the rate of combustion rises as the amount of hydrone in admixture with it is increased, up to a certain point; hydrone apparently plays a peculiarly active part in its combustion, primarily through incorporation into its being In fact, it is difficult to think of hydrone as active in conjunction with carbonic oxide except by giving rise to formic acid, the two molecules cannot well grip each other at all with any other result." That carbonic oxide can directly grip with hydrone to form formic acid seems to be an advance on the doctrine that no chemical action can take place between two molecules unless there is a third and conducting body to act as go-between, but obviously in this instance, as with hydrogen chloride, the hydrone plays a double part. It can 'grip' or 'disperse itself over' carbonic oxide, and then "given the initial production of formic acid, all else in the behaviour of carbonic oxide is clear."

Prof. Armstrong complains that his work has not been appreciated, his explanations not heeded. "Since 1885," he writes, "my voice has been that of one crying in the wilderness." But the voice of one crying in the wilderness—as prophesied by Isaiah—surely was listened to Are we not told that not only Jerusalem went out to hear, but "all Judæa, and all the region round about Jordan"? The voice has been heard, but is not the answer more nearly that pagan rejoinder, "Credat Judaeus"?

# Scientific Research and the Veterinary Profession.

The Physiology of Reproduction in the Cow. By John Hammond. Pp. xvi + 226 + 33 plates. (Cambridge. At the University Press, 1927.) 21s. net.

IN the modest preface to this book, the author expresses his hope that it will be of use to those who engage in research on the subject he deals with, and at the same time form a reference book for advanced students in agriculture and veterinary science. We have confidence that his hopes will be fulfilled.

Those who have learnt to value the care and

accuracy which characterise all Mr. Hammond's work will find in this book increased reason for appreciation of those qualities in the author. It is not only a masterly exposition of the physiology of reproduction in the cow; it also deals in a truly scientific spirit with gynæcological problems of the first importance to members of the veterinary profession, and therefore to their clients, the practical breeders

The volume is divided into (1) a short account of the breeding season; (2) the cestrous cycle, which occupies the bulk of the book; (3) pregnancy; and (4) sterility. The method of investigation the author adopts will be best disclosed by a brief survey of the section on the cestrous cycle.

Mr. Hammond examines the periodicity and rhythm of the œstrous cycle in relation to the time of year, the age, the state of fatness, the effect of drugs, the psychological effect of proximity of the bull, the effect of service of the bull, and the result of artificial removal of the corpus luteum; and wherever possible supports the conclusions he arrives at with elaborate tables of figures. The duration of cestrus he treats in a similar elaborate manner, and comes to the conclusion, which we think is justified by his records, that the length of the cycle and the duration of œstrus are correlated phenomena. But the main portion of this section is devoted to a detailed account of the physiological, anatomical, and histological changes which take place throughout the whole of the organs concerned with reproduction during the œstrous cycle, and with the mammary gland; a most painstaking and valuable piece of work.

It is impossible to do justice, in a critical sense, in the space at our disposal, to what may be described as a monograph of more than eighty pages containing fourteen elaborate tables and illustrated by a prodigal number of drawings and photographs contained in nineteen admirably executed plates. Much of it, of course, consists of a critical examination of work done by others. and when we add that the author's bibliography contains references to four hundred books and papers, some idea may be gained of the labour involved in the work. A welcome feature of this portion of the author's duties is his generous appreciation of the work of others and his judicial tolerance in criticism. We would assure him that the weight of his judgment is not decreased thereby.

Mr. Hammond's account of the anatomical and histological changes which take place in the ovaries during the cestrous cycle are specially worthy of

note, more particularly, perhaps, in relation to the Graafian follicle and to the corpus luteum. Much of this is new, and in some ways highly suggestive, while the tables and figures he gives are illuminating. With some of his general conclusions we are in entire accord, as, for example, in his refusal to accept the theory that the ripening of the Graafian follicle is the direct cause of menstruation. On the other hand, we have failed to convince ourselves of the truth of the view that the duration of the corpus luteum solely controls the length of the estrous cycle, a view which he finds reason to accept

If we must particularise, however, it is Mr. Hammond's original work on the mammary gland, on its growth, the histology of its development during feetal life, and from birth to the age of puberty, and the relation of different forms of development to the production of milk, which strikes us as fraught with matter of special scientific importance and economic value.

The section concerned with pregnancy contains a valuable résumé of the work of a host of observers on a variety of domesticated animals; it is, in fact, a comparative study of more considerable interest to the scientific worker than to the practical breeder, though of undoubted value to the veterinary student. Here and there, however, these observations have practical significance, as for example the correlation between the time when the proportion of feetus exceeds that of the feetal fluids, and the liability to infection with *Bacillus abortus*.

The changes which take place in the uterine tissues during pregnancy are very fully described and of much interest; especially in regard to the destructive action of the feetal membranes on the cotyledons, and the attachment of the foctal placenta thereto by finger-like growths which eat their way into the tissues of the cotyledons, where they are interlocked by growths of the maternal connective tissue and do not project freely into blood lacunæ. The occurrence of pustules on the internal surface of the amnion and their relation to the amount of mucus in the amniotic fluid is recorded, but beyond the fact that they are said to contain large quantities of glycogen and that they are temporary structures, nothing seems to be known of their metabolic function. It occurs to us that the association of their breakdown and the simultaneous cessation of the secretion of feetal fluids with the glandular phase of growth of the udder, are correlated phenomena which it might be worth while to investigate. In this section also

the work done on the histological changes which take place in the udder, and the nature of its secretions at different stages of pregnancy, is of marked value.

It is to be hoped that the brief concluding chapter on sterility may be extended when a call is made for the next edition of the book. There is no subject associated with the breeding industry, especially the breeding of thoroughbred stock, of greater importance than this, and there is no subject of which both the man of science and the veterinary profession are more profoundly ignorant.

W. H.

## Scientific Studies in a Swiss Nature

(1) Der schwerzerische National-Park. 50 kunstlerische Aufnahmen von J. Feuerstein. Pp. 1v + 48 Tafeln. (Zurich: Brunner und Co. A.-G., n d.) n p

Reserve.

(2) Vegetationsentwicklung und Bodenbildung in der alpinen Stufe der Zentralalpen. Von J. Braun-Blanquet unter Mitwirkung von Hans Jenny. (Mém. de la Soc. Helvétique des Sci. Nat. Vol. 63, Mém 2, 1926) Pp. viii+181-349. (Geneva, 1926)

ROBABLY few whose pursuits have not brought them into wide as well as intimate contact with Nature, can realise the extent to which the face of the globe has been modified by the restless activities of the human race. The modifying influence of man is more particularly experienced by the organic film which tends to cover, now thickly, now thinly, those portions of the surface of the earth which are capable of supporting life. Nowhere, perhaps, is this influence more noticeable than in the case of vegetation. For this reason plant ecologists have up to the present tended where possible to select for study the more 'natural' types of vegetation, i.e. those least altered by man and his domestic animals. It is gradually coming to be realised, however, that many of the problems of agriculture, dealing as it does with 'semi-natural' vegetation such as pastures, as well as with vegetation in its most 'artificial' aspect, the crops of arable land, are really ecological problems.

Though, however, no doubt ecology in the future will occupy a not unimportant position amongst the applied sciences, in this, as in other cases, pure science is fundamental. Such experiments, therefore, as that now in progress on a large scale in the Swiss National Park, are being watched by ecologists with considerable interest. The

- Swiss "Commission for Nature Protection" is to be congratulated on its decision to allow natural processes to operate in this area of upwards of fifty square miles, entirely free from the disturbing influence of man. Here man is content to stand aside, and merely to observe and record. The two works reviewed below deal with this great Nature reserve, but from very different points of view.
- (1) The first is merely a 'Nationalparkalbum' of some fifty photographs by J. Feuerstein, with forewords by Prof. Schroter and H. Federer. Yet the album is worthy of its subject, for Herr Feuerstein is at once a skilled photographer and an enthusiast thoroughly familiar with the Park and its inhabitants. Artistically and technically the photographs reach a high standard; they are well reproduced, and most of them are of whole plate size. The photographs themselves possess considerable scientific interest. The landscapes give a good idea of the ecological character of the district, especially of the coniferous forests on the mountain slopes and the alpine zone above. There are some excellent photographs of a few wellknown plants such as Ranunculus alpestris and Crocus albiflorus, and of a number of animals. The latter include the marmot, chamois, roe deer, ibex, foxes, and the kite and other birds. One particularly attractive photograph shows an alpine hare seated on the snow.
- (2) The second of the two works under consideration is an important contribution towards the scientific exploration of the Swiss National Park, dealing with the development of both soil and vegetation above the tree limit. The vegetation in question is well seen in several photographs in the 'Album.' Dr. Braun-Blanquet is responsible for the vegetational portion of the memoir, and Dr. Jenny, of the Agricultural-Chemical Laboratory, Zurich, for that devoted to soils. The work has gained greatly by this co-operation.

The underlying thesis, well established by convincing evidence, is that soil and vegetation undergo a parallel genetic development. Both exhibit initial an l transitional stages, and both tend towards a more or less stable ultimate condition, the soil climax and the vegetation climax respectively. Soil development is primarily conditioned by climatic factors, especially temperature, precipitation, and evaporation. The combined action of these factors ultimately produces a definite soil type which occurs, under similar climatic conditions, on every geological or petrographical substratum where soil formation

1 See article by Prof. C. Schröfer, NATURE, Sept. 29, 1923; vol. 112, p. 478.

has progressed to the final stage. The soil type then is a function of climate, and it should be possible therefore to speak of a 'climatic climax' in the case of soils, as we already do in the case of vegetation In the humid climate of the alpine zone in the Central Alps the progression, owing to leaching and the accumulation of humus, is invariably from basic or weakly acid soils towards a strongly acid climax—the alpine humus soil. This order of development is irreversible. So far as plant succession is concerned, the gradual changes in soil reaction are accompanied by a struggle between the pioneer species characteristic of basic or less acid soils, and invaders capable of flourishing in increasingly acid soils. The climax community, on the strongly acid alpine humus soil, is dominated by Carex curvula. There is thus a very close parallel between soil succession and plant succession. The authors regard the progressive changes occurring in the soil as the immediate cause of plant succession, the climate mainly affecting this succession indirectly through the soil.

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Another point of general interest is the apparently great importance of wind-borne dust. This dust aids in the building of soils; compensates to some extent for the leaching out of soluble salts -thereby, in the case under consideration, retarding plant succession; is a source of mineral nutriment for plants-indeed the chief source, according to the authors, in the case of shallowrooted plants growing in acid humus soil: and finally, serves to infect the soil with spores and seeds. The authors quote the opinion of Treitz, expressed at the International Soil Conference at Prague (1924), to the effect that "the most important soil-forming and plant-forming climatic factor is the annually deposited amount of windborne dust." At first frankly sceptical regarding this somewhat sweeping generalisation, the authors investigated the matter for themselves, by collecting and therefore immobilising blown dust in 'rain totalisators,' placed at two elevations in the Val Cluoza. The results obtained were truly remarkable. At the upper station, for example, above the tree limit at an altitude of 2340 m., the dust was collected continuously for two years. The average deposition over this period worked out at about 6.46 tons of dust per acre per annum, of which - about 1-63 tons were CaCO<sub>3</sub>. Such heavy manuring by wind action alone seems almost incredible, but if true would justify the authors' opinion that alpine vegetation depends for its supply of mineral salts to a great extent on wind-borne dust. Similar

experiments would be well worth carrying out in Great Britain. Hitherto, with the obvious exception of accumulations of wind-blown sand, little or no attention has been paid by ecologists to what seems likely to prove an important factor of the plant environment.

The memoir contains a mass of careful detailed work which cannot be dealt with here, beyond saying that Dr. Braun-Blanquet has described and analysed a large number of plant associations forming the complex of communities leading to that dominated by Carex curvula. He has, moreover, attempted to group these associations into alliances, according to their floristic relationships. On the whole, the monograph is certainly one of the best that has so far emanated from the Zürich school.

R. H. Y

## Psychopathology.

An Outline of Abnormal Psychology. By Prof. William McDougall. Pp. xvi + 572. (London: Methuen and Co., Ltd., 1926.) 15s. net.

EDICAL psychology has had a long and varied history. In its earliest stages it dealt with magical and pseudo-religious phenomena, which it took at their face value. Even within the last century it remained mainly anecdotal, with a complacent acceptance of the miraculous and the supernormal. With the earlier investigations and writings of scientists still among us, such as Dr. Pierre Janet and Dr. Morton Prince, it passed into the stage of detailed descriptions of outstanding cases of mental abnormality, especially of hysterical cases with their startling characteristics of dissociation and susceptibility to hypnotism. Only within the last thirty years has it taken on the characteristics of a definite sciencethat of psychopathology—with a systematic classification of its subject matter and a set of general principles genuinely explanatory in nature. In the course of its development it has profited greatly by the advance of normal psychology, but is now reacting strongly upon the latter science, deepening its conceptions and revealing the presence of dynamic factors in the normal mind which would otherwise have remained unobserved and unsuspected.

In Prof. W. McDougall's "Outline of Abnormal Psychology" we have the first serious attempt at a systematic and detailed text-book on the subject. It is a sequel to his already well-known "Outline of Psychology," and is written on the lines of general

psychological theory there set forth. In a series of thirty-four chapters, all the main aspects and problems of the science are fully dealt with. Throughout the volume detailed descriptions of typical cases, to the number of sixty in all, are given, which furnish a solid empirical foundation to the theoretical superstructure. Although full accounts are given of the chief schools of thought in modern psychopathology, such as those of Janet, Morton Prince, Freud, Jung, and Adler, these are successfully pressed into service to illustrate the author's own systematic psychological theory, the vitality of which is shown by its power to assimilate much that is characteristic of each of them. In this respect McDougall is representative of a flourishing school of psychopathology and psychotherapy especially prominent in England at the present time.

Certain minor points may be singled out for qualified criticism. The theory of causation of exaltation and depression (manic-depressive insanity), in terms of the instincts of self-assertion and self-abasement, would seem to be too simple. It does not allow for the large part played by 'disappointment in love,' understood in the widest sense, often found in these cases when deeply investigated. Again, the author unduly minimises the correlation of pronounced hypnotic phenomena with those of hysterical dissociation. This is no doubt not unconnected with his readiness to accept at their face value the manifestations of alternating and multiple personality. its turn, involves him in the necessity of producing an ingenious but singular theory of 'monads' in telepathic relation with one another to explain the forms of internal communication and lack of communication within these split personalities. Such monads are different from their Leibnizian prototypes, since the latter 'had no windows.' Moreover, to bring in telepathy as a thoroughgoing explanatory factor in this way seems perilously near explaining ignotum per ignotius.

We should bear in mind the alternative possibility that the phenomena of multiple personality may be in the main artefacts, due to the hypnotic methods of investigation and treatment employed by their observers. This would fit in with the fact that during the recent European War, in which severe forms of functional nervous derangement were produced by the thousand, no well-marked cases of multiple personality were reported or observed. Cases of extensive amnesia, fugues, etc., were numerous; but the first aim of the army doctors in the battle areas was to remove these

amnesias and re-associate the patients as quickly as possible, so that the latter might be either returned to the line or sent down to the base with the minimum of delay. Moreover, we should not overlook the part played by drama, or rather melodrama, in producing well-marked phenomena of multiple personality.

Finally, Prof. McDougall makes a vigorous onslaught upon the theory of 'abreaction' or psychocatharsis as a working off of pent-up emotion leading to recovery. But in explaining the beneficial results of this method as due to a re-association of the mind, he is only restating the theory of his selected opponent, set out in publications already some years old. The essence of his opponent's theory was that the rearousal of disturbing emotional experiences with sensorial vividness was in certain cases alone adequate to produce a re-association of the mind with the requisite degree of completeness. The reassociation must be an emotional one as well as an intellectual one.

These matters are, however, of subsidiary importance. In its powerful sweep, firm grasp of detail, and vivid and lucid style, the book stands out as one of the most important contributions to psychopathology of the present time.

WILLIAM BROWN.

## Our Bookshelf.

(1) The Food of some British Wild Birds: a Study in Economic Ornithology. By Dr. Walter E. Collinge. Second revised and enlarged edition. Pp. xix + 427 + 9 plates. (York: Published by the Author, Yorkshire Museum, 1927.) n.p.

the Author, Yorkshire Museum, 1927.) n.p.
(2) The Birds of the British Isles. By T. A.
Coward. (The Wayside and Woodland Series.)
Third Series Comprising their Migration and
Habits and Observations on our rarer Visitants.
Pp. xi+308+127 plates. (London and New
York: Frederick Warne and Co., Ltd., 1926.)
10s. 6d. net.

(3) British Birds. Written and Illustrated by Archibald Thorburn. New edition. In 4 vols. Vol. 4. Pp. x + 154 + plates 145-192. (London: Longmans, Green and Co., Ltd., 1926.) 16s. net.

(1) ALTHOUGH Dr. Collinge modestly calls this a revised edition of his work of 1913, it is virtually a new book. In place of the twenty-nine species formerly considered, the feeding habits of seventy are now discussed in detail, a considerable number being sea-birds, which had no place in the earlier work. The data for most of the species have been extended, the volumetric system of analysis, now universally adopted in the United States of America, has been superimposed upon the numerical

system, and the useful chapters dealing with general aspects of the economic relationships of birds have been added to and expanded. On the whole, it is surprising in how many cases an analysis of the food stuffs taken over a long period tells in favour of birds usually condemned as unmitigated pests, even although the statistics here given reckon against the bird much in the food content which can be of no agricultural value. The statistical methods adopted in such investigations still fall far short of scientific precision and leave the final judgment to personal interpretation with wide margins, but until better methods are evolved, Dr. Collinge's book will remain the standard British work on the subject

(2) For the average naturalist this third volume completes the most attractive and useful of the lesser books on British birds. As a practical guide to species it is less essential than its forerunners, since it deals mainly with rare and casual visitors. It is illustrated by many fine coloured drawings reduced from Lord Lilford's standard work. But it breaks new ground by introducing several chapters dealing with general aspects of British bird life, including a lengthy and excellent account of migration, and descriptions, family by family, of characteristic migratory and other habits. The sixteen 'sub species' added to the British list since the earlier volumes appeared are here described, as well as two species since recorded for the first time from Great Britain.

(3) The appeal of Mr Thorburn's work rests largely upon the beautiful and accurate coloured plates, the finest of their kind, which make identification of species a pleasure and a matter of comparative simplicity. Since, except for a number of rare and closely related species, all the British birds appear in these 192 plates, descriptive matter has been reduced to a minimum, and the text is confined to short accounts of range and characteristic habits.

- (1) Civilisation or Civilisations: an Essay in the Spenglerian Philosophy of History. By E. H. Goddard and P. A. Gibbons. Pp. xvi+231. (London: Constable and Co., Ltd., 1926.) 7s. 6d. net.
- (2) Sunrise in the West: a Modern Interpretation of Past and Present. By Adrian Stokes. Pp. xvi+168. (London: Kegan Paul and Co., Ltd., n.d.) 7s. 6d. net.
- (1) In a preface to "Civilisation or Civilisations," Dr. F. C. S. Schiller, with a characteristic and mildly cynical humour, discusses the reasons for teaching history and briefly expounds the philosophy of that subject as an attempt to formulate a 'law.' The book itself is intended to familiarise English readers with the ideas of Spengler's book, "Der Untergang des Abendlandes," in which the belief in progress was challenged. Holding that civilisation does not show any steady arithmetical progression, Spengler propounds a 'law of civilisations' to account for their rise and fall. Human achievements are divided into nine groups or eras, each constituting a distinct civilisation capable of

high achievement in art, in science, in thought, in religion, and in social organisation. Each of these passes through a course of progress covering about 1400 years, after which the society ceases to be artistic, social, or scientific in any but the crudest sense. Western civilisation, beginning about A.D. 900, is expected to come to an end about A.D 2300. It will be seen that this theory of history involves a return to the schematisation of progress, and indeed the authors will have nothing to do with the archæologist who traces cultural phenomena back to their origins or with the diffusionist and his migrations of culture from an original centre in Egypt Either school may perhaps be content to await the verdict of the facts—when we know them.

(2) "Sunrise in the West" is essentially modern in outlook and in language—both to the plain man a little obscure. The culture of the west is reviewed as a progress in the relation to one another of the 'poetry' and 'prose' of human expression. Our present position is a stage before the apotheosis of western civilisation, and the flame of the Western Spirit is a 'blue vision' which the author himself characterises as "an unsatisfactory expression, no doubt"!

The Riddle of the Tsangpo Gorges. By Capt. F. Kingdon Ward. Pp. xv + 328 + 16 plates. (London: Edward Arnold and Co, 1926.) 21s. net.

THE Tsangpo River, the main source of the Brahmaputra, flows placidly, from west to east, across Tibet until it reaches the eastern end of the Himalayan range, and vanishes into a terrific gorge. The bottom of the gorge is 9680 feet above sea-level, and the peaks that hem it in on each side rise to more than 21,000 feet. The river emerges from the mountains some 35 miles away, and is then flowing south and west at an elevation of less than 2000 There was, therefore, a chance that the gorge might conceal the most stupendous waterfall. Part of the gorge was explored by Bailey and Morshead in 1913, and most of the remainder by Captain Kingdon Ward and Lord Cawdor in 1924. No large falls were found, and it is now clear that none exists.

The main purpose, however, of Captain Kingdon Ward's expedition was not the exploration of the gorge, but the collection of plants and seeds. In this corner of Tibet the climate varies from tropical to arctic, and from humid to arid, within a range of a few miles, and the flora varies with the climate. It is a wild garden stocked with countless species and varieties of flowers and flowering shrubs; hillsides blazing with rhododendrons; fields of lilies; meadows of primulas; giant snowpeaks above, and below the abyss, echoing with the thunder of the hidden river.

The book is very modestly written, and the dangers and difficulties that were faced and surmounted in the gorge are mostly left to the reader's imagination. It is probable that they will not be fully realised until some other explorer attempts to follow in the footsteps of Captain Kingdon Ward

and Lord Cawdor The expedition owed much to the hospitality of the Tibetans, and to the courage and endurance of the men and women who, at the risk of life and limb, carried their loads up and down the almost vertical cliffs of the gorge The book is illustrated by excellent photographs, some of which must have been taken from very perilous positions. The last two chapters of the book are by Lord Cawdor, and give a short account of the natives of Eastern Tibet and their customs.

Reports of the Progress of Applied Chemistry, issued by the Society of Chemical Industry Vol 11, 1926. Pp. 742. (London The Society of Chemical Industry, 46 Finsbury Square, E.C 2, 1927.) 12s 6d., 10s. to Fellows of the Chemical Society, or 7s. 6d to members of the Society of Chemical Industry.

ONE is accustomed to anticipate with some eagerness the publication of the annual reports on pure and applied chemistry by the Chemical Society and the Society of Chemical Industry, respectively The eleventh volume (1926) of the latter series will occasion no disappointment In fact, it is unusually comprehensive; it is readable and yet as full as ever of catalogued information, and, moreover, it has appeared promptly. It is not surprising that constant reference is made to the impression left by last year's dispute in the coal-mining industry on the progress of applied chemistry; however, the difficulties of that period have at least focussed attention on fuel economy, on more fruitful ways of using coal, and on the possibility of meeting future demands for liquid fuel.

It is noteworthy that the period under review saw the establishment of the Institution of Fuel Technology and the Fuel Section of the Society of Chemical Industry. The fermentation industries, also, continue to grow in importance; the butyl alcohol—acetone fermentation is now being harnessed to the commercial production of hydrogen. Harington's work on thyroxin is recorded as the most notable advance in the chemistry of the hormones.

A. A. E.

Wireless Loud-Speakers: a Practical Manual describing the Principles of Operation, Performance, and Design. By Dr. N. W. McLachlan. Pp. viii + 139. (London: Iliffe and Sons, Ltd., 1927.) 2s 6d. net.

This book describes in a simple way the main principles used in the design of various modern types of loud-speaker. Both the amateur and the expert will find in it much that is instructive. The musician who judges from the average loud-speaker reproduction of to-day is forced to conclude that at the best it is only fair. The performance of even the best loud-speakers is far from ideal. The musical ear soon detects resonances in the reproduction, and sometimes it soon ceases to give pleasure. It is also necessary that there should be no falling off in the reproduction of notes in the scale having frequencies between 40 and 400 cycles and also in the scale from 2000 to 4000 cycles. In

the former case the bass, and in the latter the upper harmonics, are almost lost. In practice the ear finds a great difficulty in judging which of several imperfect instruments is the best. It seems to be a matter of taste. It has to be remembered that the radiation of sound from a horn loud-speaker is in the form of a divergent beam, the best quality being obtained when the aperture of the horn points directly to the listener. With a cone diaphragm the radiant beam is wider and extends on both sides of the diaphragm. Owing to the focussing effect the reproduction is best with the concave face to the front. In certain cases, however, this is somewhat modified by reflection from the walls of the room.

Entwicklungsgeschichte der mineralogischen Wissenschaften. Von P. Groth Pp. v + 262 (Berlin: Julius Springer, 1926.) 18 gold marks.

This essay on the historical development of the mineralogical sciences is especially interesting in being from Prof. Groth, who has been a leader in these subjects for half a century and has now reached the age of eighty-three years. It is divided into two sections—"Krystallkunde" and "Mineralkunde"—and the period covered is up to the end of the nineteenth century; that is, previous to the recent developments in crystallography due to X-ray methods.

The early history of mineralogy and crystallography are closely interwoven, but now they must be regarded as distinct sciences. Crystallography is no longer an aid only to mineralogy, but also to chemistry and physics—a fact that is well brought out in the present sketch. Besides chapters on geometrical crystallography there are others on physical and chemical crystallography, and on the recognition of the connexion between the form of crystals and their optical properties. The mineral section contains chapters on the crystallography of minerals and the optical determination of rockforming minerals, and on the chemistry of minerals, including the study of their alteration and artificial reproduction. Some account is given of the more important mineral collections in various countries and of the work that has been done on the material so collected. An appendix gives an interesting series of biographical sketches of the more prominent past workers.

The Story of Reckoning in the Middle Ages. By Florence A. Yeldham. With an Introduction by Dr. Charles Singer. Pp. 96. (London, Calcutta and Sydney: George G. Harrap and Co., Ltd., 1926.) 4s. 6d. net.

THE increasing number of teachers who are becoming interested in the history of mathematics will welcome this little book, which is divided into two parts, treating respectively of the abacus and algorism. Admirable diagrams enable the reader to perform simple calculations with the abacus, and the chapters on algorism throw considerable light on the evolution of our modern methods of computation.

## Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE No notice is taken of anonymous communications.]

#### An Aspect of the Biochemistry of the Sugars.

As is well known, the d-galactose configuration may be derived from that of d-glucose by a simple optical inversion at position 4 as shown in the annexed conventional symbols:

$$\begin{array}{c|cccc} H & OH & & H & OH \\ HO & H & & HO & H \\ H & OH & \longrightarrow & HO & H \\ H & OH & & H & OH \\ d\text{-Glucose} & & d\text{-Galactose} \end{array}$$

Although no suggestions as to a probable mechanism of this important transformation have hitherto been advanced, the explanation becomes obvious when certain developments in the theory of the Walden inversion and related simple optical inversions are taken into account. Lapworth, in the course of his studies of the mechanism of the formation and hydrolysis of esters, has pointed out that carboxylic esters and sulphonic esters are normally hydrolysed, and suffer fission generally, at the points shown by the dotted lines:

In harmony with the requirements of this theory, Phillips has found that optical inversion occurs in the fission, for example, the acetolysis of d-benzylmethylcarbinyl p-toluenesulphonate. The results are summarised by the scheme:

with inversion;

$$(II.) \xrightarrow{\text{Ph.CH}_2} C \xrightarrow{\vdots} COR \xrightarrow{\text{Ph.CH}_2} C \xrightarrow{\text{Me}} C$$

without inversion.

In reactions of type I., inversion is normal but not inevitable, since special conditions may induce a direct replacement. Thus there is little doubt that inversions in the carbohydrate group, though not occurring in the hydrolysis of acetates, carbonates, acetone compounds, etc., could be brought about by the formation and hydrolysis of sulphato or arylsulphonyl compounds. The theory which applies to derivatives of sulphuric acid applies also to derivatives of phosphoric acid since, putting it crudely, phosphorus has much affinity for oxygen, and having once acquired the element will be difficult to part from it. Therefore hydrolysis of phosphoric esters will be in

accordance with the scheme  $R = O(PO)(OH)_2$ , and if

the oxygen atom is directly attached to an asymmetric carbon atom, optical inversion should be observed.

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Bearing in mind, then, the occurrence of hexosephosphates in Nature, it seems certain that the galactose configuration results from the hydrolysis of a glucosephosphoric acid which may occur as such or form part of a larger molecule. An interesting sideissue is the indication of the probable constitution of the glucosephosphoric acid, and the fact that the present hypothesis, permissible on the basis of Haworth's six-ring glucose formula, would be excluded if glucose contained the butylene oxide ring. The reverse change from galactose to glucose will naturally have the same mechanism.

In discussing the matter recently with Prof. W. N. Haworth and Dr. E. L. Hirst, it was pointed out that the above suggestion throws an interesting light on the nature of the pentose in the nucleic acid derived from vegetable nucleo-proteins. has obtained from this source a pentose-phosphoric acid which on hydrolysis yields d-ribose and phosphoric acid and is therefore considered to be a ribosephosphoric acid. It is much more likely to be d-xylosephosphoric acid, the ribose being produced in accordance with the scheme ·

 $(\mathrm{HO})_2(\mathrm{PO}) \overset{\mathrm{H}}{\overset{\mathrm{OH}}{\overset{\mathrm{OH}}{\overset{\mathrm{H}}{\overset{\mathrm{OH}}{\overset{\mathrm{OH}}{\overset{\mathrm{C}}}{\overset{\mathrm{C}}{\overset{\mathrm{C}}}{\overset{\mathrm{C}}{\overset{\mathrm{C}}{\overset{\mathrm{C}}{\overset{\mathrm{C}}}{\overset{\mathrm{C}}{\overset{\mathrm{C}}}{\overset{\mathrm{C}}{\overset{\mathrm{C}}}{\overset{\mathrm{C}}}{\overset{\mathrm{C}}{\overset{\mathrm{C}}}{\overset{\mathrm{C}}}{\overset{\mathrm{C}}{\overset{\mathrm{C}}}{\overset{\mathrm{C}}}{\overset{\mathrm{C}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}}{\overset{C}}}{\overset{C}}{\overset{C}}}{\overset{C}}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}{\overset{C}}}{\overset{C}}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset{C}}}{\overset{C}}{\overset{C}}}{\overset{C}}{\overset{C}}{\overset{C}}{\overset$ H OH + H<sub>3</sub>PO<sub>4</sub> d-Xylosephosphoric acid

The circumstance that we are able in this way to regard nucleic acid as a derivative of the relatively widely distributed xylose instead of the rare or unique ribose must undoubtedly be regarded as strongly supporting the thesis advanced. The d-ribose could also be obtained from a d-arabinose-phosphoric acid or from l-lyxosephosphoric acid, but d-arabinose and t-lyxose do not appear to occur naturally, and consequently the assumption of the origin from d-xylose is preferable. Finally, without going into detail, it may be pointed out that a consubtraction of the facts in relation to the theory of hydrolysis and optical inversion indicates that the first stage, involving fission of a bond, in the hydrolysis of a glucoside is the opening of the oxide ring.

R. Robinson.

The University, Manchester, June 24.

## Friction of Solids.

THERE seems to be but very little published information regarding the subject of solid friction, and such as there is is chiefly concerned with the effects of lubrication at considerable velocities and at comparatively low pressures.

I think, therefore, it is worth while to contribute a short note on some experiments which I have recently made, in which the pressure between the solids range from those ordinarily met with in mechanical practice up to the highest which the material can withstand 1 and in which the velocities are almost vanishingly small. A list of the materials tried and of their coefficients of friction is given below.

The point worthy of remark is the small difference which exists between the coefficients for the various metals notwithstanding their strong contrasts in other respects. Another point which seems remarkable is that when the pressure is high, the presence of a lubricant nearly always increases instead of diminishing the coefficient of friction.2

<sup>1</sup> An example of friction at destructive pressures is presented by the driving-band on the projectiles of large guns. The great volume of smoke which 'smokeless' powder produces when such guns are fired consists almost entirely of powdered driving-band, i.e. of finely divided copper

The effect of a 'drop' in the saucer in preventing a cup from slipping is very generally known.

In these experiments a small plate of sapphire was always used as one of the pair of substances the mutual friction of which was to be determined, because, as was found after many trials, where one of the pair was so hard as to be free from any chance of being

The tray A was supported on three steel balls rolling on steel guides, and it was found that the resistance offered to the travel of the tray was less than a ten-thousandth of the load carned by it.

In making an experiment the tray was brought to

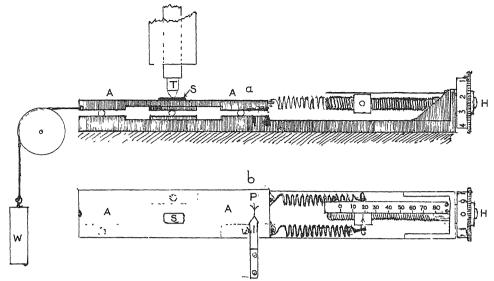


Fig. 1 —Apparatus used in the measurement coefficient of friction—a, side elevation, b, plan, A, tray folling on steel balls, S, sapphire plate, T, test piece, P, zero mark on tray, I, index, II, divided head, controlling spring balance

scratched, the coefficient depended solely on the properties of the softer material.

As mentioned in my letter published in NATURE of May 7, the sapphire plate was carried on a tray

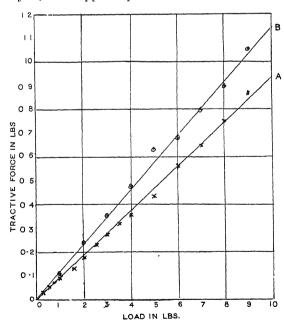


Fig. 2 —Diagram showing the results of two sets of experiments on the coefficient of friction of steel on sapphire

× Individual observations when the surfaces are dry.

• " " in oil

The ratio ordinate/abscissa=coefficient of friction

which could be dragged literally under the loaded test piece by the action of a spring balance. The apparatus, somewhat improved, is shown in Fig. 1, a and b.

the zero position by turning the adjusting screw H of the spring balance until the mark P on the tray coincided with the index I

COEFFICIENT OF FRICTION BETWEEN METAL AND

Metal	Coefficient of Friction.	Load,	Pressure
Steel	0 10 0 11 0·11 0·105 0·105 0·114 0·105 0·115 0·115 0·135 0·10 0·111 0 095 0 075 0 10 0 135 0·85 0·95 0·108 0·09 0·108 0·099 0·108	The loads were mcreased by quarter lb, from 0 to 1 lb. " half lb, from 1 lb, to 4 lb " lb from 4 lb to 9 lb.	Pressure = load by measured area of contact.  This ranged up to 300 tons per square unit for steel.  " hmiting pressure for the other metals.

D indicates that the surfaces were clean and dry. L " " lubricated.

To make the zero definite a counter weight W was added to give an initial tension to the springs. The

test piece with its appropriate load was then allowed to piess on the sapphire and the tray (by means of a screw nut shown in the sketch) was shifted slightly in the direction to extend the balance spring. This screw was slacked back and the mark P again brought to coincide with I by turning the divided head H.

The balance reading then gave the force which was just sufficient to cause sliding between the test piece

and the sapphire.

In Fig. 2 one complete experiment is plotted in detail, in order to show the kind of accuracy with which the relation between the tractive force and the load is determined by this method. All the experiments were plotted in the same way, and the order of accuracy is much the same on each. The average results are given in the table on p. 45.

Lubrication was effected by putting a drop of heavy oil on the sapphire before placing the test piece in position. Some very general causes must underlie the approximate equality of all these coefficients, but the explanation would require a knowledge (which does not at present exist) regarding the intimate conditions at solid boundaries.

A. MALLOCK.

9 Baring Crescent, Exeter.

## The Scattering of Electrons from Single Crystals of Nickel

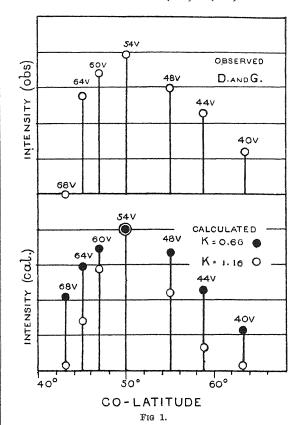
In a letter to Nature (vol. 119, p. 558; April 16, 1927, hereafter cited as loc. cit), Messrs. Davisson and Germer have communicated the results of some very interesting experiments on the scattering of electrons from single crystals of nickel. They show that the distribution of scattered electrons, which have only lost a small fraction of their energy, depends on the voltage, and is in accordance with the symmetry of the crystal. The authors explain their results approximately on the basis of the Einstein - de Broglie theory of the wave electron, in a similar manner to that suggested by Elsasser (Naturwiss., 13, p. 711, 1925) in explanation of earlier experiments of Davisson and Kunsman (Phys. Rev., 22, p. 243, 1923). particular, the explanation given is that electrons of velocity v are scattered by the nickel crystal in very nearly the same directions as those in which an electromagnetic wave of wave-length  $\lambda_s = h/mv$  would be diffracted by the cross grating formed by the uppermost layer of atoms in the face of the crystal—in this case, a (111) face which has been etched by vaporisation.

The alteration in intensity (with varying voltage) of the reflection with maximum at 50° in the {111} azimuth for 54 volt electrons [loc. cit., Fig. 1] is not explained by diffraction at a cross grating. another control which brings out the one reflection as a maximum with the partial suppression of the neighbouring ones. The control is not the complete one which would be exercised by a space lattice. This would entirely suppress all reflections but the maximum. The necessary degree of control would be provided by the influence of a second cross grating lying beneath the first. The observed position of the maximum (i.e. at 54 volts,  $50^{\circ}$ ) can then, however, be explained only by the assumption of a spacing between the two gratings equal to  $Ka/\sqrt{3}$ , where K=0.66 or 1.16 and  $a/\sqrt{3}$  is the normal spacing of the {111} planes of a face-centred cubic lattice of constant a. At these distances the diffracted beams from the two layers are in phase for 54 volts. The two factors two layers are in phase for 54 volts. differ from one another in corresponding path length by one wave-length.

It must be pointed out that the factor K is not quite

the same for all reflections. The calculated maximum intensities for the various voltages in the neighbourhood of 54 volts for the above values of K are shown in the figure, compared with the observed maximum intensities [loc. cit. Fig. 1]. (No corrections have been applied for general scattering.) The positions of the maxima agree with those observed within the error of reading of the published curve. The agreement in height of the maxima is almost equally satisfactory in the two sets. There is a possible preference for  $K=1\cdot16$ , as the existence or non-existence of a peak may be a better criterion than the comparison of intensities. It may be necessary to take a slight effect from the third layer into account.

The variation of intensity with azimuth in colatitude 50° has also been calculated [loc. cit. Fig. 2]. The ratio of the maxima {111} · {100} has been



calculated to be 4:1; that of the observed values, making allowance for general scattered radiation, being of the order 2:1. This agreement is satisfactory when it is realised that atom factors for the gratings will have to be taken into account.

The reflections in azimuths  $\{111\}$  and  $\{100\}$  for 110 volts are not explained by diffractions in a crossgrating parallel to (111). On the suggestion of Prof. von Laue that faces other than (111) were present on the etched surface, the diffractions from the cross gratings parallel to a few of the most probable subsidiary faces were calculated. The assumption of the existence of faces  $\{\bar{1}11\}$  would explain the reflection in the  $\{111\}$  azimuth, giving a value of  $n(\lambda mv/h) = 2(1.06)$ . The reflection in the  $\{100\}$  azimuth can possibly be explained as a diffraction of the same type in the  $\{\bar{1}11\}$  faces of minute twin crystals, which are rotated through  $60^{\circ}$  on the surface of the main crystal.

It is reasonable to assume that an alteration in the

lattice is to be found near the surface of a crystal. Whether an increase or a decrease takes place seems to be an open question. An application of the electron lattice theory of Haber would suggest that the nickel atoms would be repelled, and the spacing increase (cf. Madelung, Phys. Zerts., 20, p 494, 1919). The point is, however, not very clear. That the surface of an etched crystal is not perfectly plane, and that many faces of the order of ten to a few hundred atoms in extent are present, is also to be expected.

It is not profitable to carry the discussion further on the basis of the results which could be communicated in the scope of a letter to NATURE. ment of these results with calculation seems to indicate that the phenomenon can be explained as a diffraction of waves in the outermost layers of the It also appears, which may be crystal surface. even more important, that a complete analysis of the results of such experiments will give valuable information as to the conditions prevailing in the actual surface of the crystal, and that a new method has been made available for the investigation of the structure of crystals in a region which has up to the present almost completely escaped observation. Calculations on the above lines will be continued when a more detailed account of the experiments is available.

In conclusion, the writer wishes to express his thanks to Prof. M. von Laue for the very kind interest which he has taken in discussing this problem.

A. L. PATTERSON, National Research Student (Canada). Kaiser Wilhelm-Institut für Faserstoffchemie, Berlin-Dahlem, Germany. May 26.

### The Origin of Speech.

It is well known that the gestures of articulation which produce the consonants L, T, and K are not always made respectively in exactly the same position in the mouth, and that the exact position is more or less dependent on the vowel with which the consonant in question is associated.

Actually, the consonant gesture tends to be made near the position at which the tongue approaches the palate to form the central onfice between the front and back resonators which produce the required pair of vowel resonances.

Examination of the actual resonance - changes produced by the consonant gestures of L, T, and K, in association with different vowels, showed that the acoustic effect of a consonant gesture varied very greatly according to the position in which it was made.

Thus the initial resonance of L in the syllable Li (lee) is about 4 semitones higher (in my voice) that that of L in lu (loo). Similarly, in the case of ti and tu the difference of resonant pitch is 14 semitones, while between ki and ku the difference may be so much as 20 semitones.

These differences of resonant pitch are much greater than those by which we normally distinguish such vowel sounds as i (eat) and ei (hay), or æ (hat) and e (earth), or A (up) and a (calm); yet we normally hear all these consonants as the same—whatever be the vowel with which they are respectively associated.

The conclusion which was drawn from these (and other) observations was that, in appreciating speech, the human mind is not primarily interested in the sounds—which are due to changes of resonance—but rather in the gestures of articulation by which these changes are produced.

We therefore normally accept, as identical, speech

sounds which may be very different in pitch or in change of pitch, if we recognise that they are made by the same gesture of the tongue—even though that gesture may, for convenience, be made in different positions in the mouth when associated with different vowels.

To test the assumption that speech is essentially a matter of gesture, the attempt was made to 'fabricate' a number of words symbolising such simple actions as to dig, wave aloft, shake (like shaking a mat), stab, scrape, etc. The method of formation was to imitate, with the tongue, a pantomimic gesture, such as might also have been made by hand, and to phonate or grunt while making the tongue-gesture.

The phonetic results of these combined gestures and grunts were submitted to Dr. Neville Whymant, who kindly undertook to compare them with early Polynesian, Melanesian, and Japanese words of similar meaning.

As the result he was able to produce close phonetic counterparts from these languages in the case of 11 out of 12 fabricated words. Thus, for to dig, the fabricated word was tadi or tari—the actual Protopolynesian word is tarn, for wave aloft the fabricated word was ledhl-ledhl or ledl-ledl—the actual word is

To test whether the same principle of word formation had been operative in the Aryan languages, the experiment was made of comparing the meanings of a number of Aryan roots which differed only by a single consonant sound—as, for example, the roots LA, LAS, LAGH, and LAK.

It was found that, in the case of about 130 words thus compared, each separate consonant imported a characteristic element of meaning, and that this meaning was pantomimically related to the gesture by which the consonant was produced.

Thus LA—which is due to the sudden lowering of the tongue from contact with the palate—has the meaning 'to be low'

The consonant S is produced by pressure of the tip of the tongue against the back of the front teeth, so as to make a constriction in the front of the mouth.

S consequently denotes a grip or a bringing to a point in a forward position.

Actually, LAS means 'to glean,' that is, to be low and grip or pick in front of one.

GH is due to a partial closure of the back of the tongue against the back of the throat—the sensation being that of flattening the tongue out in the mouth.

Actually, LAGH means to lie down. K is due to a complete closure (and release) of the

back of the tongue against the soft palate. Actually, LAK means to bend or depress—the

forcible K closure importing the idea of stress.

Similarly, R (made apparently with a reflexed tongue as in Wessex and very generally in the United States) commonly denotes a bending back or surrounding, while L symbolises vertical movement, up or down.

Besides the roots which form comparable series, there were found a large number of isolated wordslike DHIGH to smear, WID to see, DU, DUK, or TUH to lead—which give similar evidence of gestural origin. In the case of WID the lips and tongue appear to imitate the human eye, while in DU, DUK, and TUH the lips make a pointing gesture.

Altogether some 320 roots have been found which

show signs of pantomimic origin.

It would appear, therefore, that human speech began by the performance of sequences of simple pantomimic gestures of the tongue, lips, etc., comparable with the natural gestures (of hands, etc.) which are still made by deaf mutes, and that these gestures were made audible by breathing or grunting.

In this way a single polysyllabic 'word' would denote a sequence of actions (or of actions and related

objects), in other words, a 'sentence.'

Since these results were formulated I have learnt that a practically identical theory was put forward in Sept.-Oct. 1862 by Dr J. Rae of Honolulu, in three articles published by The Polynesian, copies of which I have now seen in the British Museum Library (Press Mark—General Catalogue—P.P. 9899. 6).

Dr Rae's conclusions were drawn from a study of

Polynesian word-formation

It is remarkable that, though Prof Max Muller was acquainted with Dr. Rae's articles (see his "Science of Language," Second Series, 1864, pp. 10 and 89), he did not appreciate their importance, or see the light which they threw on the origin of the Aryan roots and of human speech in general.

R A. S PAGET.

1 Devonshire Terrace, W.2, June 6

## Preliminary Note on a Glow in Hydrogen at High Pressure.

DURING an experiment in which an attempt was being made to get atomic hydrogen by means of an incandescent tungsten filament in wet hydrogen, a quite unexpected glow was discovered The apparatus consisted of a three-litre bulb in the bottom of which there was sealed a tungsten filament from a 300-watt electric-light bulb. The pressures varied from 2 cm. to 35 cm., the hydrogen being generated by the electrolysis of potassium hydroxide. No care was

taken to dry the hydrogen or to purify it.

The glow was observed as follows. The filament was allowed to come to incandescence, the observer very carefully shielding his eye from the direct light of the filament. On extinguishing the filament and then opening the eyes, it was possible to see a weakly luminous ball of vapour, blue in colour, rising from the filament and spreading out into an umbrella-shaped cloud at the top of the bulb. This glow persisted for about a second and then disappeared. The act of disappearance was a characteristic one, the glow appearing to collapse from the wall of the bulb to its centre. The speed with which the glow shot up from the filament increased with increased pressures. Below 2 cm. and above 30 cm. the glow was no longer observed.

It was found that after the filament had been run steadily for about thirty minutes it was no longer possible to observe the glow. However, on letting the filament stand for about ten minutes it recovered its former power to give the glow. We suspect from this that the glow is caused by something which is liberated from the incandescent tungsten filament, the fatigue of the filament being due to the filament's having given up all the carriers of the glow.

When fresh hydrogen was allowed to enter the bulb the filament did not give the glow until it had been flashed about ten or twelve times, after which it recovered its former ability to give the glow.

In order to eliminate the possibility that the glow may have been due to excitation of the hydrogen by electrons from the filament which had been accelerated due to the potential drop along the filament, a filament was used which became incandescent and gave the glow on only 55 volts. This immediately eliminated the above possibility, because the lowest excitation potential of  $H_2$  is at 11 4 volts.

Several attempts were made to photograph the

spectrum of the glow, all with no success. ever, by the use of colour filters it was possible to show definitely that the glow extended at least from 5000 Å.U. to 4400 Å U. Therefore, although there are as yet no photographs, there is very little doubt in our mind as to the nature of the spectrum. think that the spectrum is continuous because it is hard to see how such a weak spectrum can extend over a range of more than 600 Å.U. and be anything else. An attempt is now being made to determine the nature of the carriers of this glow.

Joseph Kaplan

Physical Laboratory, The Johns Hopkins University, Baltimore, US.A.

#### Anomalies in the Properties of Long-Chain Compounds.

During the course of an investigation into the nature of adhesion (on which I have been engaged with Prof. J W. McBam on behalf of the Adhesives Research Committee of the Department of Scientific and Industrial Research), it has become evident that many of the properties of certain long-chain compounds become anomalous at (or in the immediate neighbourhood of) the 5th, 10th, and 15th carbon atoms in the chain. This is of theoretical interest in connexion with the form which the carbon spiral assumes in particular homologous series.

As is well known, the combined X-ray data of various investigators lend support to the idea that some form of carbon spiral or zigzag exists in certain long-chain compounds; and on certain assumptions the disposition of the earbon atoms in the chain has been more precisely defined. It is desirable, however, that data other than those of X-ray spacings should be considered in this connexion; for example, properties

relating to the molten state or to solution.

According to the stereochemical view, a continuous chain of five carbon atoms would be expected almost to return on itself; and it is reasonable to suppose that a similar disposition of the carbon atoms would recur at the 10th, 15th, etc., carbon atoms. In this event the properties of similarly constituted compounds might be expected to show at least a tendency to periodicity with increase of molecular weight. Evidence of such a periodicity in the molecular rotatory power of the ethyl-R-carbinols (R=alkyl) was obtained by Pickard and Kenyon (Jour. Chem.

Soc., p. 1924, 1923). From a consideration of such properties as static friction, adhesion, cohesion, surface tension, density of packing and electrical properties of monomolecular films on water, optical activity, magnetic rotation, dissociation constants, toxicity, together with other data, it appears that cumulative evidence can now be adduced indicating that anomalies or turning points exist in many of the properties of certain longchain compounds at (or near) the 5th, 10th, and 15th carbon atoms of the chain. (It is intended to publish the detailed evidence shortly.) The abnormality is usually most pronounced at or near  $C_{15}$ , the anomalies being smaller in the neighbourhood of  $C_5$  and  $C_{10}$ . It is considered that publication of the data may stimulate research into the question of periodicity in the properties of long-chain compounds, quite independently of the various X-ray investigations now in progress.

W. B. LEE.

Department of Physical Chemistry, The University, Bristol, June 20.

## Observations of the Total Eclipse of the Sun, June 20.

THE sense of personal disappointment of the astronomers who were prevented by clouds from observing the total eclipse on June 29 gives place readily to feelings of relief that in spite of persistently bad weather the spectacle was witnessed by many expectant people. As Prof. Turner rightly commented in the Times of June 28, the possible technical gains to astronomers on this occasion would take second place beside the general advantage of the public. On account of the uncertainty of favourable weather, the shortness of

the duration of totality, and the low elevation of the sun at the time, this eclipse was not favourable one for the specialists ineclipse problems.  $\overline{\mathbf{A}}\mathbf{s}$  a possible opportunity, however, for many people to see various the phenomena of a total eclipse for the first and only time of their lives, the occasion justified all the careful preparations made on every side for its occurrence.

Three months ago the railway companies regarded the suggestion that a special train might be run to

a place in the eclipse track as scarcely a business proposition. One company replied that, though the event might be of interest to a few astronomers, the public was not likely to pay much attention to it. Within a few weeks of the eclipse, however, it became evident that a very large number of people intended to get within the zone of totality on June 29; and the railway companies with lines in or near the eclipse track found that they could fill all the trains they could run, or for which convenient stations or sidings were available. In addition to the thousands who travelled by rail, very many more journeyed to the track by motor-cars, and during the night of June 28 there was an almost unending procession of cars driving to the main roads within the track.

Such a great pilgrimage to view an astronomical

phenomenon was in itself most remarkable, and though only perhaps about a quarter of a million people actually saw the glorious shrine of the sun's corona, vet every one within the zone of totality was impressed by the accuracy of the timing of the eclipse (the difference between prediction and observation was less than three seconds) and the eerie darkness of the total phase There was a sigh of relief in the watching crowds when the sky began to light up again after the sudden gloom.

Those of us who are familiar with celestial move-

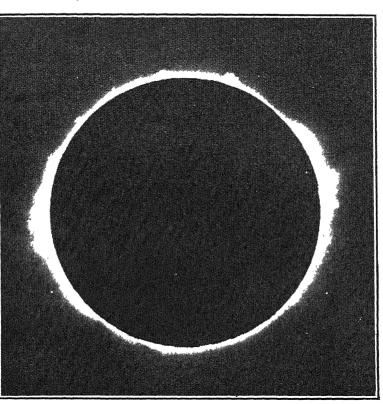


Fig 1.—Photograph of solar prominences and inner corona taken at the Astronomer Royal's observing station at Giggleswick, Yorks, during totality on June 29 Exposure 20 sec., using a 6-in lens of 45-ft. focus by Alvan Clark, kindly lent by Mr James H Worthington.

stand how completely wonderful the prediction of eclipses appears to be to the mind of the general public. Most people have only the vaguest ideas as to the sizes. distances, or motions of the sun, moon, and earth, and to many of them the dark body of the moon seemed to be actually a disc touching the sun. One lady was heard to say that she was afraid the thing would stick upon the sun instead of passing right across. It is true that the periodical press

ments can

scarcely under-

has done much to enlighten the public by means of descriptive and illustrated articles as to the nature and cause of eclipses, and never in the lifetime of any of us has so much space been devoted to an astronomical subject. The Daily Mail in particular took the lead months before the event, and near the day of the eclipse, as well as a day or two later, every daily newspaper made it a leading feature. Reporters and press photographers invaded every station where astronomical instruments were set up, and opinions as to promise or performance were eagerly sought and copiously printed. It is stated in the *Times* of July 4 that 22,000 press telegrams on the eclipse were dispatched from Settle on June 27-29. The London *Evening News* may be congratulated upon a remarkable achievement in this connexion. The Astronomer Royal's

photograph of the corona taken at Giggleswick was developed by ten o'clock on the Wednesday morning, and a representative of the Evening News was permitted to copy the negative He went at once to Leeds by motor-car, and from there his photograph was taken to London by aeroplane, with the result that a reproduction appeared in the Evening News of the same day. By the courtesy of that journal we are able to reproduce the same photograph in NATURE (Fig I). The original negative at the Royal Observatory, Greenwich, shows, of course, more detail, yet the picture here reproduced illustrates how successfully the Astronomer Royal's party took advantage of the good fortune given it during the fine moments of

50

totality.

Though glimpses of the corona were obtained at a few other places, no photographs comparable with that secured at Giggleswick were obtained elsewhere in England or Wales. At Gilling, near Richmond, Yorks, Sir Francis McClean had erected a camera with a lens aperture of 6 inches and focal length of 31.5 feet for the photography of the corona, but he and his brother, Capt. W. N. McClean, as well as Dr. Lockyer, Director of the Norman Lockyer Observatory, who hoped to obtain a photograph of the eoronal spectrum, were prevented by thick clouds from doing anything useful during totality. Similar depressing weather conditions prevailed at most places and prevented observational work, either visual or photographic, by Prof. Fowler at South Kensington, Prof. Newall and the Cambridge party at Aal, Norway, and Prof. Mitchell at Fagerness. It is reported, however, in the Times of June 30 that at Ringebu, in Gudbrandsdal, and at Nyborgmon, in Finmark, weather conditions were perfect and excellent observations were made and photographs taken by Profs Saland and Vegard at the former, and by Prof. Linke and M. Krogness, Director of the Geophysical Institute of Tromso, at the latter.

Whilst sympathising with the many disappointed astronomers who had prepared and hoped for successful observation, it cannot but be felt that the combination of circumstances, such as they were, could not have been happier. In the first place, the Astronomer Royal's party was able to carry through successfully its intended programme, in spite of a serious handicap to the adjustments of instruments imposed by continuous bad weather for a fortnight before the event. Only those who have at least seen something of the preparations required in setting up an eclipse camp can appreciate the skill, concentration, and anxiety involved, and all will rejoice at the Astronomer Royal's good fortune in being at the most favoured place on June 29. At Southport also, a town at which the largest number of people had congregated, a satisfying, although not perfect, view of the eclipse was afforded. Prof. Turner, who has done so much to forward public interest in the eclipse, must-feel highly gratified at his happy selection of Southport for his observing station, to which people gravitated in such large numbers.

An account of the intended programmes of

work proposed at various eclipse stations was given in the Supplement to NATURE for June 18 Work was practicable, however, at three only of these At the Astronomer Royal's camp at stations Giggleswick, the very successful large-scale photograph of the corona already mentioned was taken with an exposure of 20 sec Photographs of the flash spectrum, whilst not completely successful. on account of the lightly-veiled sky, should give useful information. At Southport, the site of the joint expedition from the University and Radcliffe Observatories, Oxford, two photographs were obtained with the astrographic telescope One of these photographs developed during the following afternoon gave a moderately good image of the corona, the other plate being reserved for special treatment at Oxford A pair of polariscopic plates, taken with the similar components of the Abney lens, showed that qualitatively, at any rate, the method employed was successful At Stonyhurst, where the vagaries of the weather were especially evident, the programme arranged by the director could not be carried out owing to cloud, but a visiting astronomer, the director of the Coimbra Observatory, Portugal, was able, in another part of the grounds, to complete two kinematograph films, which it is hoped will show the formation of Baily's Beads. In an aeroplane (kindly placed at the disposal of the Astronomer Royal by the Daily Mail) at a height of 11,000 feet over Darlington, two members of the staff of the Royal Observatory, Greenwich, secured three smallscale photographs showing the corona and its These photographs would have been extensions of special use in defining the type of corona and tracing its extensions if the sun had been completely hidden at all land stations.

The most interesting features of the eclipse appear to be as follows:

The Moon's Shadow.—The approach and retreat of the moon's shadow as a definite boundary were clearly seen by Dr Gerald Stoney from a ridge a few miles north of Richmond, Yorks. To most observers, however, the shadow was simply an increasing darkness. It was noted generally that the increase of light after totality was apparently more rapid than the decrease before totality. The progressive changes of colour as totality approached and passed have been fully described by eyewitnesses in and adjacent to the zone of totality. The most remarkable effects were evidently seen from the air.

Bally's Beads —Several people reported having seen this phenomenon, which occurs immediately before and after complete totality. It is possible, however, that in some cases this may have been confused with the appearance of bright prominences. An account of a spectroscopic observation of Baily's Beads, succeeded by the appearance of the flash spectrum, is given by a correspondent in the Yorkshire Post for June 30.

Solar Prominences and Chromosphere.—The prominences were a striking feature at totality, four or five being visible to the naked eye. The largest of these, near the sun's north pole, was easily seen

by most people, its height was estimated to be 50,000 miles The day previous to the eclipse, Prof Fowler, observing at South Kensington, detected this prominence spectroscopically only sunspots near the sun's limb at the time of the eclipse were placed at position angles 70° and 257° respectively, measured from the north point of the image. The colour ascribed to the chromosphere and prominences by the majority of observers was pink, red, or scarlet It is of interest that the Greenwich observers and their associates in the aeroplane agree in the statement that at a height of 11,000 feet, where the sky was so clear as to be a deep Oxford blue, the colour was a lustrous silver white This divergence of colour estimate might well be a point for observation at future eclipses.

THE CORONA —The type of the 1927 corona is that previously found associated with maximum sunspot activity In shape it resembles that of the 1905 corona (An article dealing with the forms of the corona and their origin was contributed by Dr W J. S. Lockyer to NATURE for June 18, p. 93.) A remarkable feature of the 1927 corona was the brightness of the inner zone One or more extensions were seen, the estimated length for the longest being about 12 solar diameters

We are glad to be able to publish the subjoined details of observations made at various stations

#### GIGGLESWICK.

The Royal Observatory observers at Giggleswick were Messrs Davidson, Jackson, Melotte, and Woodman They arrived a fortnight beforehand in time to meet their instruments, which had been sent from Greenwich by Admiralty lorry. were joined later by Messrs Greaves and Horrocks, and on June 24 by the Astronomer Royal site kindly placed at their disposal by the governors and headmaster of Giggleswick School was a field behind the chapel, from which the morning sun was seen over a hill rising to an altitude of  $4^{\circ}$  to  $6^{\circ}$ . On the morning of the observers' arrival, the sun was seen in a perfectly clear sky at the time of the eclipse, but for thirteen successive days was invisible at this time. During this fortnight rain and wind hampered the observers, but the greatest trouble was the absence of any continuous spells of sunshine This made the final adjustments of the spectroscopes very difficult and somewhat uncertain.

On the day of the eclipse the observers were kept on tenter-hooks, but the sun was visible in a slightly hazy sky for 10 minutes before the total phase. Mr. Horrocks had a chronometer and called out, from the calculated times,  $10^{\,m}$  .  $5^{\,m}:2^{\,m}:1^{\,m}:$  $50^{\rm s}:40^{\rm s}:30^{\rm s}$   $20^{\rm s}:10^{\rm s}$  before totality. The commencement of totality was 3s before the revised predicted time. This was observed by the Astronomer Royal and coincided with the time when Mr Davidson, watching the image, cried 'Go.' Mr. Horrocks from this zero counted seconds.

The duration was 23<sup>s</sup>.

Dr. Jackson exposed a plate in the 45-foot camera from 1s to 21s. A very sharply defined picture of the inner corona on the large scale of 5 inches to the sun's diameter was obtained. The extension is not great, but the detail is very fine.

The spectra of the 'flash' were only partially successful

The observers in the aeroplane provided by the Daily Mail were Messrs Greaves and Witchell of the Observatory staff and Mr. Hargreaves, an amateur astronomer who has been very successful in photographing faint comets. On his advice, hyper-sensitised panchromatic plates were used. With these, three photographs were taken with exposures of  $\frac{1}{13}$ s,  $\frac{1}{10}$ s,  $\frac{1}{30}$ s. The plates show the extension of the corona well, but the longer exposures are affected by shake. The success of this party was due in great part to the magnificent piloting of Capt. Barnard He found a hole in the high alto-stratus clouds and kept the aeroplane in it at the critical time.

The third Greenwich expedition was not so fortunate The Hydrographer kindly arranged for the survey ship H.M.S. Fitzroy to be in the belt of totality during the eclipse Messrs. Edney and Chamberlain took cameras of 27 m. and 20 m. focal length working at F/4.5 and F/5.6 respectively. But the sky was completely covered and nothing could be done

There were no less than 100,000 visitors to the Settle and Giggleswick district who obtained a magnificent view of the eclipse. Among them were a number of boys and girls from West Riding towns like Huddersfield and Keighley. The educational effect of this unforgettable sight is not the least valuable result of the eclipse F. W Dyson.

I observed the eclipse at Giggleswick from a point in the Chapel Field a few yards to the west of the Royal Observatory party. With me were Messrs R. W. H and J Davies, who assisted me greatly in the erection and adjustment of my The only photographic work atinstruments tempted was with a small home-made slitless spectograph fitted with a transmission grating mounted on a prism. The clear aperture was  $l_2^1$  mehes, and the spectrum was focussed by a spectacle lens of 32 inches focal length. The scale of the spectrum thus formed on the plate was about 500 Å U. to the inch. The plate used was a super speed panchromatic, made and kindly presented by the Imperial Dry Plate Company. The speed was estimated by the makers at about 1250 H. & D., and the sensitiveness extends well down into the red, to about  $\lambda7500$  A half-plate was used, and this included about 5 inches of the red end of the spectrum, from  $\lambda 5000$  to the limit above stated. Fairly satisfactory photographs of the flash spectrum were secured at both second and third contacts, exposure at the latter being made by Mr. J. Davies  $\dot{H}_a$  and  $D_3$  are shown as large arcs, the former more than  $180^\circ$  in extent, and there are about a score of reversed metallic lines, mostly in the green; but the plate has not yet been examined in detail.

The majority of totality was devoted to a simple visual scrutiny of the corona with a 3-inch Merz comet-seeker having a power of 17 and a field of 3° 10'. With this instrument the intense brilliance of the lower corona was very striking. It certainly

greatly exceeded the intrinsic brightness of the full moon and seemed to approximate to that of an incandescent mantle. The colour was pure silverwhite, while that of the prominences was rose-pink, or perhaps more nearly cerise The four principal rays of the outer corona seemed to be arranged fairly symmetrically round the disc, and the general appearance was that of a typical maximum corona These rays were very much fainter than any part of the lower corona, but could be traced out to at least a full diameter of the moon. More than one was observed to exhibit a double curvature of outline, and in all there was a marked tendency to radial striation or subdivision. The rays seemed scarcely so white as the lower corona. Instead, they appeared slightly cream coloured, but the somewhat hazy sky may have had something to do with this

At third contact I moved the telescope so as to place the reappearing crescent just outside the field of view. The lower corona and prominences were then still conspicuously visible and remained so for at least half a minute. After this, as the light increased, the corona became gradually fainter, besides growing narrower through the encroachment of the moon's disc, but it could be clearly held until 3 minutes and 5 seconds after third contact This moment corresponded to a 94 per cent. obscuration of the sun. There was much absorption and scattering of the sunlight by haze, and the sky against or through which the corona was seen was very bright Had the atmosphere been transparent and a somewhat higher power been used. I feel fairly confident that I could have seen the corona for at least another minute, and possibly a little longer still. In any event, my observation seems to lead to the interesting conclusion that, given clear weather and a suitable instrument, the lower corona could have been seen at this eclipse from practically every part of the British Isles. Certainly from places near the zone of totality, such as Manchester, Leeds, and Newcastle, it would have been a conspicuous object. W. H. STEAVENSON.

### SOUTHPORT.

The members of the Oxford expedition, Prof. H. H. Turner from the University Observatory, and Dr. H. Knox-Shaw and Mr. H. G. S. Barret from the Radcliffe Observatory, arrived at Southport on June 22, and immediately commenced setting up their instruments in a cycle shed of the King George V. School, which with the ready assistance of the Southport Director of Works was quickly converted into a comfortable observatory. As mentioned in NATURE of June 18, the instruments consisted of the astrographic object-glass of the University Observatory with a portable tube, fed by a 16-in. ccelostat, for direct photography of the corona; and the two components of a 4-in. Dallmeyer doublet (the Abney lens), each of 5 ft. focal length, with two cameras containing plates of plate-glass, blackened at the back, just within the focus, reflection off which polarised the

light in two directions at right angles. These cameras were fixed on an equatorial mounting

The weather was almost uniformly bad during the week of preparation. The instruments were set up approximately in azimuth by means of an excellent plan of the shed prepared by boys of the school, and accuracy to within about a degree was secured in this way. The collostat commanded only the morning sky, and a glimpse of the sun on the morning of June 25 provided the means of its final adjustment in azimuth. Intermittent sights of the sun on June 28 enabled the collostat clock to be rated. As there were no clear nights, the focus of the three telescopes was determined in the school dark-room by a photographic autocollimation method

On the night before the eclipse there was a short interval when the stars were clearly visible, but it clouded up before dawn and there were no patches of clear sky again until the following afternoon. Throughout the period of the cclipse there was a uniform sheet of thin cloud over the sky and considerable lower cloud as well, from which the sun was fortunately clear from 5 h 10 m. (summer time) until about a quarter of an hour after totality, except for a few anxious minutes after six o'clock, when it was almost entirely absorbed. Through this thin cloud exposures of 5 sec. and 2 sec. were made with the astrographic telescope, and a plate was exposed in each of the polariscopic cameras simultaneously for 18 sec.

The latter plates, on which photometric wedges had been impressed at the Clarendon Laboratory, with the kind co-operation of Mr. I. O. Griffith and Dr. G. M. B. Dobson, have been developed, and show differences which seem definitely to be due to polarisation in the corona. It is doubtful whether they will prove of any photometric value owing to the presence of cloud, but it is gratifying to find that this simple and inexpensive method of obtaining photographs of the corona in polarised light, which should be within the reach of amateurs, promises to be successful The 2 sec. exposure with the astrographic telescope was also developed at the school. Although weak, it shows a narrow corona and several prominences, one of them showing a distinct arch. The 5 sec. exposure with this camera was taken back to Oxford to have a wedge impressed on it before development. All the plates show absorption by cloud over the lower limb of the sun.

The observation of the time of second contact indicates a correction to the predicted time of minus 2 or 3 seconds, but this, as in the case of the observation made at Giggleswick, will require confirmation, when the accurate position of the station is determined. A number of persons saw several prominences quite distinctly with the naked eye.

The headmaster (Mr. G. A. Millward) and the staff of the school, and the Mayor and Corporation of Southport, gave every assistance in their power. For the observations at totality the expedition was assisted by Mrs. Turner and Mr. E. B. Knobel, who with fans made the exposures at the two

instruments; by Mr. J. H. Reynolds, who attempted without success, as did Mr. Barrett, to observe the flash spectrum with a direct-vision spectroscope; by Messrs D. C Leech, R Thompson, and C Woodham, masters at the school, who worked the apparatus which provided the wireless time signals from Greenwich and called out the seconds of totality, and by several boys of the school, who booked the times of the various exposures

## Meteorological Observations.

The maximum of wind velocity occurred at 5 28 or 5 29 G.M T, and the maximum 'backing' of wind direction at 5.30 The reduction in velocity was only 2 or 3 miles per hour, namely, from about 6 to about a 4 miles per hour wind, the recovery being the same. The backing of direction was 28° (from a point 146° from north through east to 118°), and the recovery afterwards practically as much.

Temperature fell only 0°4 F. by the M.O thermograph in the Stevenson screen, but 0°9 by the dry bulb of the Assmann aspirated psychrometer. The minimum occurred at 5 34.

The wet bulb fall was  $0^{\circ}$  6 by the Assmann At 5.35 the dry and wet bulbs were only  $0^{\circ}$  9 apart (dry =  $47^{\circ} \cdot 9$  and wet =  $47^{\circ}$  0)

The open-scale barogram shows nothing whatever that can with any certainty be associated with the eclipse.

The grass minimum temperature (by a special thermometer as sensitive as a mercurial one) was 44°8.

Not the slightest char was made on the card of the sunshine recorder all the morning

Joseph Baxendell.

#### DARLINGTON

As I was one of the fortunate few who saw the eclipse on June 29, a brief account of my experience may be of some interest I spent the previous night at Darlington with my party, and a little before 5 30 we went out into the streets in a quiet part of the town. The eastern sky was cloudy, and it was some ten minutes before we could locate the sun, but at last, about 545, there was a break in the clouds and it was seen that the moon had already bitten, so to speak, a fairly large crescent into the disc. Clouds were continually passing, but at intervals we saw the gradual progress of the moon across the sun's face. As the time of totality approached, a mass of cloud advanced and completely obscured the sun, and after 6.20 an extraordinary pall of darkness fell upon us, which we took to mean that totality had begun. We had all but given up hope of seeing what we had gone so far to see, when suddenly the sun disengaged itself, and we saw the black disc of the moon with a fiery belt all around it, and then bursting out from the top right-hand corner came a flash of blinding light which seemed to take the form of two ovoid excrescences. Immediately afterwards, more cloud came up through which we could just make out a thin sickle of light on the right of the moon, and then we saw no more But our effort had been well rewarded.

George A. Macmillan

#### EDINBURGH

Preparations were made at the Royal Observatory, Edinburgh, for observing the 'flash' during the partial phase. The great solar spectrograph with 40-ft focus O.G and Rowland concave grating of  $21\frac{1}{2}$  ft radius was adapted for the purpose by introducing a right-angled prism in the beam so that the tip of the cusp could be rotated tangentially to the slit. The weather, however, proved unfavourable The crescent of the sun was glimpsed at maximum phase (0.98) through low, rainy cloud, but not for long enough to turn the spectroscope upon it, even visually.

R. A. Sampson

#### STONYHURST COLLEGE

At Stonyhurst, owing to a small cloud covering the sun at time of totality, the plates, which were all exposed according to programme, show nothing with the exception of that on the Dallmeyer portrait lens camera attached to the 15-in. equatorial. The eclipsed sun was slowly emerging from the small cloud mentioned above during the last 4 or 5 seconds of totality, and the result on the plate was a fairly complete ring of the chromosphere, the prominences on the west limb, and a trace of the corona to about one-third of a solar diameter beyond the prominences.

TIMES OF CONTACT.—At time of first contact the sun was partially immersed in cloud and no obser-

vation was possible.

The time of second contact, 5 h. 23 m 58.9 s. G.M T., was well determined by Father Rowland observing through a prismatic monocular magnifying 8 diameters, the Rev. J. Lawrence, S.J., timing with the Frodsham half-seconds chronometer, of which the correction had been determined from the Greenwich radio signals at 4 h G.M.T. The rapidly diminishing solar crescent was distinctly though faintly seen through the cloud, until

its quite sudden disappearance

The third contact was unfortunately not so well determined. When the crescent disappeared, there was absolutely nothing left to hold in the field of view, and though the observer tried to keep the instrument directed to the assumed position of the sun, it actually drifted off, and the first intimation of the end of totality was the appearance of the emerging crescent, seen with the other eye, without instrumental aid, and immediately the signal 'stop' was called. The time was clearly late, the observer estimating the error as about  $1\frac{1}{2}$  sec. Father O'Connor, who was operating the 19-ft. prismatic camera, and was carefully observing for the first reappearance of a Baily Bead, with the view of obtaining the second 'flash,' closed down just one second before the signal 'stop' was given. Applying a correction of  $1\frac{1}{2}$  sec., the time of third contact works out as 5 h. 24 m. 20.9 s., giving a duration of totality of 22 sec.

The times of second contact and of duration had

been worked out by Dr. Crommelm as 5 h. 24 m  $\,$  0 s., and 22 sec respectively

MAGNETIC RECORDS—In accordance with the request of the Permanent Joint Eclipse Committee, quick runs of 4 hours' duration were made on the magnetographs from 4 h. to 8 h G.M T on June 28, 29, and 30. The curves obtained are beautifully clear, and throughout the periods of the quick runs on all three days the magnetic conditions were exceptionally quiet, and so were well suited to bring out any deviations from the normal effect of solar radiations as affecting magnetic conditions the curves show that there was not the slightest variation at or near the time of eclipse, it appears to be clearly established that the screening action of the moon is without magnetic effect under these conditions Whether it would produce any diminution of disturbed conditions remains an open question

METEOROLOGICAL —The barometer was steadily falling all the time from 29 342 m. at 4 15 G.M.T. to 29 326 in at 6.0 G.M T.

Readings of the thermometer were taken at every 15 minutes, starting at 4.15 G.M.T. The readings were .  $54^{\circ}.3$ ,  $54^{\circ}.5$ ,  $54^{\circ}.6$ ,  $54^{\circ}.4$ ,  $54^{\circ}.3$ ,  $54^{\circ}.3$ ,  $54^{\circ}.7$ ,  $56^{\circ}.5$ . The thermograph showed practically no variation.

Further to my earlier communication, it may be of interest to note that the time of second contact was confirmed by an independent observation made by the Rev. J. O'Hea, S.J., working with a second chronometer at a station 23 chains due south of the first station, who obtained the time of second contact as  $5^h$   $23^m$  58  $5^s$  G.M.T. By interpolation from the data on the B.A.A. Eclipse Map, the time at the second station should be  $0.36^s$  earlier than at the first station, and applying this correction the time reduced to the first station becomes  $5^h$   $23^m$  58  $86^s$ , which is in striking agreement with that actually observed there

It had been intended to observe the times of contact by noting the instant of the reversal of the Fraunhofer lines of the spectrum as the moon covered and uncovered the photosphere. For this purpose a transparent Thorp replica grating of about 14,000 lines to the inch was fitted in front of the objective of the prismatic monocular. With this instrument a beautiful spectrum was obtained, and as the solar crescent waned the principal Fraunhofer lines could be distinctly seen as curved arcs, but as totality approached the spectrum became so faint owing to the interposition of the small cloud mentioned in my previous communication, that it was realised the method might fail from lack of light, and the instrument was therefore turned direct on to the diminishing crescent.

E. D. O'CONNOR.

## RICHMOND, YORKS.

The expedition from the Norman Lockyer Observatory took up its position at Olliver Ducket, near Richmond, on June 19, and commenced operations in setting up the instruments; and the

work was completed and all in order two days before the eclipse. For the first few days the weather was farrly fine, but after that it became very wet and windy and made it very difficult to erect the tube of the 30-ft coronograph. Very little work could be done on June 21 owing to a gale, which necessitated everything being anchored down securely.

Observation of the sky every morning at the time and in the direction of the eclipse showed that on three occasions it was perfectly clear, two days thin clouds were present, and for the rest totally overcast. Three mornings previous to eclipse day thick cloud intervened

Sir Francis McClean and Capt. W. N. McClean with their staffs were each operating three instruments, and the writer with his staff four instruments. Three members of the Observatory Corporation were also located on our site and were employing one instrument each.

On the morning of the eclipse the sun when just above the horizon appeared as a red disc, but soon became hidden by clouds. At 5<sup>h</sup> 10<sup>m</sup> the clouds seemed to be breaking up and patches of blue sky appeared in the south, from which direction the light wind was coming. The valley mists appeared to be rising and dissipating, and the prospects looked hopeful at about 5<sup>h</sup> 35<sup>m</sup>

At 5<sup>h</sup> 50<sup>m</sup> the conditions seemed to be more promising, and at 6<sup>h</sup> 0<sup>m</sup> the partial phase was well seen in clear sky for a few minutes. At 6<sup>h</sup> 7<sup>m</sup> heavy clouds obliterated the sun from view, and I then thought that we should not see the sun again. This turned out to be the case. At 6<sup>h</sup> 15<sup>m</sup> the conditions were hopeless, and the sun was not seen again until half the partial phase had passed.

The system of time signals was carried out very efficiently by Capt. McClean's assistant, Mr Chapman. In addition to preliminary signals, every minute was called out, beginning at four minutes before totality, and every second for thirty seconds before totality. The greatest darkness seemed to arrive at the moment 'one second' was called. The majority of the observers carried out their programmes according to schedule, although it was known that no results could be secured During the total phase it was very dark, but no doubt the heavy clouds were responsible for this to a great extent.

It is pleasing to place on record the fact that every assistance was given to the party whenever it was desired, and special thanks are due to Capt. Nelson Rooke, acting for the Marquess of Zetland, who did all in his power to make the expedition a success.

WILLIAM J. S. LOCKYER.

#### REETH (SWALEDALE).

The Armstrong College party consisted of Messrs. H. W. Davis, T. Russell Goddard, G. R. Goldsbrough, Wilfred Hall, G. W. Todd, and Stanley Todd. The site selected was Gointar Lodge, near Reeth, Swaledale. The equipment consisted of a 5-inch photo-visual objective mounted in a fixed horizontal position, and served by a cœlostat; a

14 cm. photographic objective in an equatorial mounting and three fixed cameras of shorter focal length for instantaneous exposures These were all intended for photographing the corona were also a Hilger two-prism stellar spectrograph mounted equatorially with a Zeiss objective, an objective prism with 3-inch objective mounted equatorially, and a grating and fixed camera served by a small coelostat. These were intended for flash spectra and, if possible, coronal spectra.

During the early phases there were broken clouds which allowed occasional glimpses of the sun. There was a clearer view just before totality, and the last thin crescent was distinctly seen with The crescent Baily's Beads forming at the cusps also seemed to be tremulous Then just as totality was about to begin a thick cloud covered up the sun,

and no plates could be exposed.

Reeth—10 miles up Swaledale, west of Richmond -had moderate eclipse luck The day before looked most unpromising, but with some hope at night in spite of the gloomy weather forecast. At 3.35 AM Jupiter was visible and there were wide areas of clear sky. On arrival at our observation post, on the ridge above Marrick Abbey, a couple of miles east of Reeth, the eastern sky was covered by dense cloud, but there were clear areas to west Breaks in the clouds gave a view and south-east of the sun when a fifth covered; we saw it a dozen times, the last being about 4 minutes before totality. Then the cold seemed to condense cloud in the eastern gaps and we saw the sun no more. Eight diverging rays marked its position. They vanished suddenly at totality, and reappeared as suddenly at its end. The inky darkness below the sun was impressive, but we saw no advancing shadow from the west, and the western sky was much lighter.

On somewhat higher ground to the south, on the edge of Wensleydale above Leyburn, experiences were much the same—ten views of the sun through gaps and its disappearance 4-5 minutes before Observers on the plateau to the north of us enjoyed only one early view of the sun. Mist

rested on some hills to the south-west.

J. W. GREGORY.

#### COLWYN BAY.

Although dense clouds veiled the whole of this phenomenon from Colwyn Bay, it was possible to time the end of totality within a second or so by the passage of the edge of the moon's shadow (which was well defined on the clouds) over the known place of the sun. The time, using the wireless signals, was 5h 23m 55s U.T. Both the descent of darkness and the return of light happened several seconds before the predicted times, since these were produced by the shadow on the cloud layer above us, and as the shadow was only some 10° from the horizontal position, it reached a particular cloud several seconds before it would have reached the point on the ground vertically

below The colour of the sky during totality was a beautiful blue with a purplish tinge darkness was considerable, being increased by the thick layer of clouds A. C. D. CROMMELIN.

The Royal Irish Academy party undertook a programme of observations on atmospheric electricity at the old telegraph station at Llysfaen, near Colwyn Bay. On the mornings of June 28, 29, and 30, from 4 20 A.M. to 8 30 A.M., continuous measurements were made of the atmospheric potential gradient, of the atmospheric conductivity, positive and negative, and of the concentration of condensation nuclei. No effect attributable to the solar eclipse was detected, but any moderate change would have been masked owing to the disturbance in the atmospheric electric elements caused by the rain which fell during the eclipse Apart from the question of possible effects due to the eclipse, the examination of the results obtained is expected to give useful information in connexion with the equilibrium of atmospheric ionisation.

J J NOLAN.

The astrophysical observations which were hoped for at Llysfaen, near Colwyn Bay, were completely spoiled by clouds. No glimpse of the sun was obtained on June 29 before, during, or for several hours after the time of eclipse. One member of the party, however, who carried out experiments on wireless reception, obtained results which may be of value, and his statement is subjoined.

HERBERT DINGLE.

The special transmissions from Eindhoven, on a wave-length of 30.2 metres, were received by means of a short wave receiver, and measurements were made of the variation in signal strength over the period 4.30 to 8.30 B S.T. on the morning of the eclipse, and of the day before and after. On June 29, generally similar variations to those obtained on the other days were observed for some time before totality. During totality, however, the signals faded out completely, and the station was only heard very faintly and irregularly from then until after 7 A.M., when the reception began to improve again. The results for the normal days before and after the eclipse showed no such marked fading over the same period (6.23 A.M. to 7 A.M.).

## CRICCIETH.

Criccieth eclipse station had very heavy rain during all phases of the eclipse, and no photographs were obtained either of the corona or of the spectrum.

Dr. J. H. Shaxby, of the National School of Medicine, Cardiff, assisted by Mr. Deniol Williams, of Aberystwyth University College, took photometric measurements throughout the eclipse with particular attention to the period from 6.20 to 6.30 Summer Time, and I have asked Dr. Shaxby to send NATURE certain of the results of his work. The curve is an interesting one, although not so valuable perhaps as it would have been had we been favoured with good weather.

It was a glorious quest well worth the effort, and all the party thoroughly enjoyed the work in

spite of the disappointment

We had a 21-inch siderostat and were working from it with a 6-inch mirror of 7 ft focus, a 6-inch mirror of 24 inches focus, a two-prism objective prism spectroscope for the flash spectrum, and a grating spectroscope for the infra-red end. All our spectrum plates were special neocyanine ones with the ammonia doping to make them supersensitive

A. Taylor.

#### SNOWDON

On the morning of the eclipse a whirling mist of cloud slashed with streaks of rain narrowly restricted the range of vision on Snowdon summit but did not quench the sunlight, which it uniformly diffused. The view-point which I had chosen the day before was not upon the cairn or the platform which, with buildings, artificialise the highest peak, but a narrow spur of rugged rock about fifty feet lower, overhanging precipitous descents on either hand of which the bottom was undiscernible on either day Pointed battlements of rock a few feet distant fenced the turret of my outlook, beyond, the luminous obscurity of cloud reached from the zenith nearly to the nadir. I was alone, and no human form loomed into sight through the mist.

The wildness of the scene was enhanced by the veering and backing of a gusty wind which drove

the pelting rain upon the crags, and its monotony was unrelieved during the partial eclipse, for the murk of the morning seemed but a thickening of cloud. At length, on a sudden, there was a shutting-off of light as if a curtain had been quickly drawn part way across the window of heaven. Before I could recover from the start, a second and greater darkening occurred, as if the window had been completely curtained, and all around was the blue-blackness of night. The jutting rocks were blackest. The atmospheric background, above and below, was uniform in tint, no longer showing whirls of mist or stretches of rain.

The condition of an unusually sombre night had continued for a sufficient number of seconds to let the mind begin to broad, when I was awakened as from a dream by the dawn of a new day, miraculous from the suddenness of its light and remarkable for the quick change of tint to a ruddy The brightening of this first drawing-back of the curtain was much greater than the darkening of the first partial closing Before surprise had passed there was a second flood of light, and one felt that the window of heaven was now completely uncurtained There were no more phenomena, for ours was a total eclipse without the incidents of the partial phase. The narrowing of the view was lamentable, but the concentration in time to one breathless half-minute was extraordinarily dramatic, and the solemnity of the surroundings amply compensated for the discomforts of a lofty and exposed situation. VAUGHAN CORNISH.

## Archæological Work at Gerar.

By Sir Flinders Petrie, F.R.S.

T had long been desirable to obtain a more exact scale of dating in the archaeology of Palestine. For this purpose the Egyptian connexions were needed, and the British School of Archæology in Egypt therefore settled last winter upon the mound of the city of Gerar, nine miles south of Gaza, almost in the desert. An area of about an acre was cleared, to thirty feet deep, through six superimposed layers of building from 400 to 1500 B.C. Each chamber found was lettered on the plans, and each object found was given its chamber letters and foot level. The planning was continuous, and 2000 objects were drawn in outline for publication The record is therefore complete, without needing notebooks or card catalogues. The date of each of the six layers of building could be ascertained within ten years by the external history; the rate of accumulation happily proves to accord with the time scale throughout, to within a foot,

Iron furnaces of about 1200 B.C. were found, and by them were very large tools, as a pick of seven pounds weight, hoes, and plough points. The ore was probably hæmatite, resulting from decomposition of pyrites from the Beersheba basin. Iron knives were made from 1350 B.C., probably the earliest manufactured iron known. The flush of gold named in Judges viii. is apparent in the

many earrings and a gold frontlet which were all of that age, while none was found of later times. The influences were from the east and central Asia under Shishak, 900 B.C., but from Italy and Cyprus in 800 B.C. The business of the city was making the arms and clothing for the north-west tribes of Arabia, as now in modern Gaza The position was important as being on the road from Egypt to the Judxan hills, and also as commanding the coast road; hence the Egyptian kings fortified the place whenever they occupied Palestine. The Persians also made this an army base of supplies for invading Egypt, building large granaries to hold enough corn for 100,000 men for two months. This fertility of the plain in good seasons accords with the great number of flint sickles found, of about 1800 to 1400 BC., and the hundredfold crops named in Genesis xxvi. The Philistine settled here was apparently a corn-factor to collect grain for supplying Crete, like the Philistine at Ekron in the middle of the Shephelah corn land.

It appears that the coast must have been submerged as much as 125 feet in late Roman times, and recovered later. There are stratified silt deposits up to that level at Gerar containing Roman pottery throughout, and three miles nearer the coast the stream cuts through 50 feet of these

deposits with Roman pottery from base to top The top plane is at the same level at both places. As the valley is two miles wide and fifty feet deep, any artificial dam is improbable, and the silting must therefore have been due to an estuary reaching up to 125 ft. There are great deposits of recent shells on hills by the coast up to about 80 ft The Egyptian movement at Alexandria was at least 40 ft of submersion, and a later recovery of 18 ft. This corner of the Mediterranean needs an historical survey, including the pottery and other remains. The collection brought to London will be on view at University College, Gower Street, until July 16.

#### News and Views.

It is announced that the Secretary of State for the Colonies has appointed a Committee "to formulate practical proposals for submission to the Colonial Governments to give effect to the resolution for the Colonial Office Conference on the subject of Colonial Agricultural Scientific and Research Services " These proposals are to "include a scheme, based on contributions to a common pool, for the creation of a Colonial Agricultural Scientific and Research Service available for the requirements of the whole Colonial Empire for the support of institutions needed for that purpose, and for the increase of research and study facilities in connection with specialist services of the Colonies generally." The committee is thus constituted · Lord Lovat, Parliamentary Under-Secretary of State for Dominion Affairs (chairman), Mr. W. Ormsby-Gore, Parliamentary Under-Secretary of State for the Colonies; Sir Graeme Thomson, Governor of Nigeria; Mr. A. S. Jelf, Colonial Secretary, Jamaica; Mr. O G. R. Williams, Assistant Secretary, Colonial Office; Major R. D Furse, Private Secretary (Appointments) to the Secretary of State for the Colonies; Sir J. B. Farmer, Dr. A. W. Hill, Mr. F. L. Engledow, and Dr. A. T. Stanton, Chief Medical Adviser to the Secretary of State for the Colonies.

If reference be made to the second paragraph of the leading article in this issue of NATURE, it will be observed that to this committee has been relegated one part of the more comprehensive task given to the Committee appointed by the Colonial Office Conference at its first session. At that Conference were gathered together official and authoritative representatives from most of the thirty different colonial administrations. The scheme for agricultural research recommended by the committee they appointed involved them in a total annual cost of £175,000, the greater part of which is already a charge on their revenues. The Conference approved the recommendations of the committee, which in the main were those of a Commission on Agricultural Research and Administration in the Non-Self-governing Dependencies, appointed some years ago, the report of which had just been published. General consent might have been obtained immediately, it might be presumed, for some systematic method of determining the contributions of the various colonial governments to the central pool and matters of detail left to the Agricultural Research Council. The appointment of this further committee will inevitably involve more delay in the long overdue reorganisation of the colonial agricultural research and scientific services.

THE Golden Valley is one of the chief beauties of the famous Hindhead district, in the neighbourhood of Farnham and Winchester, and its wild and beautiful slopes, wooded with pine, birch, and hawthorn, and chequered by gorse and broom, make an essential complement to the neighbouring land secured for the people under the National Trust. At short notice the Golden Valley was put up to sale for building plots, but the prompt action of Dr. Marie Stopes in stepping in to purchase the Valley (at the surprisingly low figure of £5650) gave the residents time to form a committee to collect funds which would save the land from the builder. The completion date for the sale was June 30, but the vendors have granted a short extension, and the National Trust, to which the property would be handed over, now issues an urgent appeal for the small sum needful to complete the purchase price. Residents and local sympathisers have played their part, for already approximately £4500 has been subscribed. Less than £1500 is required, and we feel assured that so good a cause need only be mentioned to obtain the support it deserves. It would be a calamity were this spot, where artists, writers, and naturalists have gained inspiration, to become lines of villas. tions to the Golden Valley fund, so marked, should be sent to S H. Hamer, The National Trust, 7 Buckingham Palace Gardens, London, SW.1.

On July 14 occurs the centenary of the death of Augustin Jean Fresnel, the distinguished French physicist who shares with Young the honour of establishing the undulating theory of light. Born at Broglie (Eure) on May 10, 1788, Fresnel was a few years younger than Arago, Brewster, Biot, and Malus, all of whom laboured in the same field. He was educated at Caen; at sixteen years of age he passed into the École Polytechnique, and after being trained as a government civil engineer in the École des Ponts et Chaussées, was employed in various provincial departments. His important scientific work began with his paper on diffraction read to the Paris Academy of Sciences in 1815. Just as Young in England met with opposition, so Fresnel had to face the criticisms of Laplace, Poisson, Biot, and others. Fresnel, in addition to his theoretical work, made practical improvements which led to the adoption of polyzonal lenses in lighthouses adopted first in France and then in foreign countries. Towards the end of his life he acted as examiner to the École Polytechnique, but his various duties proved somewhat too much for his feeble constitution, and he died at

Ville d'Avray on July 14, 1827, at the early age of thirty-nine years. Only a few days before this, he had received at the hands of Arago, the Rumford Medal of the Royal Society, awarded him for "His Development of the Undulatory Theory, as applied to the phenomena of Polarised Light; and for his various important Discoveries in Physical Optics." Some of his memoirs lay unpublished until 1884, the year his memorial was unveiled at Broglie. These were found among the papers of Ampère and relate to electromagnetism. Fresnel's great lenses are preserved in the Paris Observatory.

The thirty-eighth Congress of the Royal Sanitary Institute will be held at Hastings on July 11-16, under the presidency of the Right Hon Sir William Joynson-Hicks, Bart. The lecture to the Congress will be given on July 12, by Sir William Willcox on "Chronic Rheumatism in its relation to Industry," and on Friday evening Sir Henry Gauvain will give an address and show a film dealing with "The Treatment and Training of Crippled Children." The business of the Congress will be carried on in seven sections and six conferences, covering various aspects of personal and public health and hygiene. A special feature of the meeting will be the conference dealing with health resorts, over which Dr. A. Rollier, of Leysm, will preside. Among the topics to be discussed at the Congress are the following: The notifiable infectious diseases of the nervous system; industry and disease; inspection and consumption of food, tubercular infection in milk; treatment and disposal of sewage. Many visits and excursions to places of professional and general interest have been arranged. The Health Exhibition, which is an important part of the Congress, will include exhibits relating to domestic health and comfort, municipal sanitation, etc.

THE provisional programme of the annual meeting of the British Medical Association, to be held at Edinburgh on July 15-23, includes many discussions, several of which are of general scientific interest. These include the following, the section or sections arranging the discussion and the opener's name being given in brackets: the results of insulin therapy in diabetes mellitus (Section of Medicine, Prof. Hugh Maclean) on July 20; immunity (Sections of Pathology and Bacteriology and Comparative Medicine, Dr. R. A. O'Brien and Prof. Carl H. Browning) on July 21; the therapeutic uses of calcium salts (Section of Therapeutics and Pharmacology, Prof. F. R. Fraser) on July 21; the duties of the State in regard to food supplies (Section of Preventive Medicine, Prof. E. Mellanby) on July 21; the structure and function of the spleen (Prof. John Tait) and the influence of internal secretions on sex characters (Dr. F. A. E. Crew) on July 21, and chemical changes accompanying muscular activity (Prof. T. H. Milroy) and hæmolysis (Dr. E. H. Ponder) on July 22 (Section of Physiology and Biochemistry); the historic evolution of disease (Section of History of Medicine, Sir Humphry Rolleston) on July 22. A feature of the meeting

will be the celebration of the centenary of the birth of Lord Lister, a meeting presided over by Lord Balfour will be held in the M'Ewan Hall on July 20, and short addresses will be delivered by Sir W. Watson Cheyne, Bart, Prof. Tuffier (Paris), Prof. Harvey Cushing (Harvard), and Dr. James Stewart (Halifax, Nova Scotia). A museum of relics of Lister will be open throughout the week in the Upper Library of the Old University. The honorary local general secretary is Dr A. Fergus Hewat, 14 Chester Street, Edinburgh.

WE learn from a Daily Service News Bulletin recently issued by Science Service, Washington, that the "dangerous fish tapeworm of Europe," Dibothriocephalus latus, which is adult in man and has become established in the United States, is to be the object of special study this summer by a group of investigators under the direction of Prof. H. B. Ward. The investigation, which is supported by the National Research Council, will be carried out in the extreme north of Minnesota, which is the centre of the infected area. The tapeworm appears to have been introduced into the United States by immigrant labourers in the iron and lumber industries, who not only carried the parasites internally but also imported their favourite dried and salt fish from their central and eastern European homelands. Salting of the fish does not kill the young stage of the tapeworm, and imperfect smoking also leaves the worm alive. There is evidence that the native fishes m some of the northern lakes of the United States may have become infected, and the investigators hope to secure definite evidence on this point and to work out methods for keeping the infection from spreading.

ABOUT two years ago the Astronomical Society of the Pacific proposed to reprint some of the popularlywritten descriptions of topical developments and discoveries in astronomy which from time to time appear in various publications, provided a sufficiently widespread desire for such reprints was manifested by the members. We have now received a batch of nine leaflets of the character indicated, from which it may be inferred that the proposal has been favourably received. They consist of double-leaved pamphlets, about 6 in. by 4 in. in size, containing 1000-2000 words, and the subjects dealt with and the manner of their treatment are well indicated by the titles: "Mira, second largest star, could engulf earth's orbit"; "Why popular interest in Mars?"; "Island Universes"; "The strange companion of Sirius"; "A close-up of the moon"; "How far away is that star, and how do you know?"; "The Magellanic Clouds"; "The Pleiades"; "The Great Nebula in Orion." The notes are written by astronomers of repute, and most of the leaflets contain reproductions of photographs illustrating the subject treated; Dr. Moore's article, for example, on the great nebula in Orion, is accompanied by an admirable view of that object. We congratulate the Astronomical Society of the Pacific on this excellent idea, which, if it meets with the success it deserves, will, we hope, be taken up by responsible bodies in other branches of science. We should like, in fact, to see the project extended beyond the boundaries of scientific societies. Religious and political organisations have long realised the value of the tract as a means of bringing their respective gospels before the public at large, and if funds are available, there appears to be no reason why the gospel of science and of education in general should not be proclaimed in a similar manner. The leaflets before us are admirably suited for such a purpose

British scientific workers tend to be conservative in their reading of the foreign technical press. It is therefore with some pleasure that one notes the increasing vogue of foreign technical abstracts in British journals. The Journal of the Royal Aeronautical Society publishes each month extracts from the scientific and technical press as issued by the directorates of technical development and scientific These are excellent as giving a short résumé in compact form of the most recent work in aerodynamics. In the May and June issues, for example, there is a number of excellent abstracts from the French and German press on the work which is proceeding in these countries on fluid motion. Experimental criticisms have been levelled by H. Benard against Karman's laws of frequency and distribution of vorticity behind an obstacle. The latter, in an excellent reply, points out the existence of surface ripples in Benard's experiments, estimates the effect due to these, and verifies his previous results. A number of abstracts deal with the rate of spread of turbulence in a viscous fluid, while others treat the problem of heat transference from liquids or gases to solid walls, a subject to which Prandtl and Karman have contributed so much in recent years. These abstracts give an idea of the inspired work which is proceeding at various German centres along these lines. It would appear that during recent years the centre of gravity of pure hydrodynamical investigation has definitely shifted to the Continent.

The current issue of the Svenska Linné-Sallskapets Arsskrift (Årgång 10, 1927) is of much historical interest. It is devoted to the publication of papers illustrative of the life and work of Linnæus, delivered at the Swedish Linné Society's commemorative meeting, which took place in his native village in Småland on May 23 of last year, the anniversary of the birth of the great botanist. Much of the material is of biographical rather than of botanical interest. Prof. Robert Fries, chairman of the Society, contributes an account of Linnæus' connexion with Småland, his early life there, and the botanical influence which helped to shape his career. Prof. H. O. Juel and Mr. G. Drake give some interesting botanical and pharmacological notes on Linnæus' "Report on the Medicinal plants growing in Sweden." Mention is also made of his abortive attempt to introduce the tea plant from China. The somewhat complex disposition of Linnæus is admirably analysed by the Rev. E. Malmestrom, who holds a brief for the great systematist's exaggerated self-esteem, and the laudatory terms in which he refers to himself. Shorter articles deal with various topics of local and historical interest.

Prof. Henry Louis, emeritus professor of mining at Armstrong College, Newcastle-on-Tyne (University of Durham), has been appointed president of the Institution of Mining Engineers in succession to Dr. J. S. Haldane. He will take office at the annual meeting in London in November.

DR. WHITMAN CROSS, of Washington, and Prof. A. G. Hogbom, University of Upsala, have been elected foreign members of the Geological Society. Prof. F. X. Schaffer (University of Vienna), Prof. C. Schuchert (Yale University), Prof. F. Slavík (University of Prague), and Dr. E. O. Ulrich (U.S. Geological Survey) have been elected foreign correspondents of the Geological Society.

A RECENT news bulletin issued by Science Service of Washington states that the State of Montana has allocated 60,000 dollars for the erection of an entomological laboratory at Hamilton, Montana, with 25,000 dollars per annum for the next two years for research there. One of the pressing problems to be investigated is Rocky Mountain spotted fever, which is conveyed by a tick. It is hoped that a parasite of the tick may be utilised for its destruction, and so the conveyance of the disease may be prevented.

A NUMBER of useful papers appear in the recently published *Proceedings* of the Chemical Engineering Group of the Society of Chemical Industry, vols. 6 (1924) and 7 (1925). The 1924 section contains four papers, two on crystallisation and two on chemical works costs. A considerable portion of volume 7, containing 17 papers, is devoted to fuel questions, but it includes articles on the internal combustion boiler, the treatment of solvents used in dry cleaning, crushing and grinding mills, aerosols in industry, and other subjects of importance to the chemical engineer. The volume of 200 pages is well illustrated, and it will be valued by all interested in large-scale chemistry.

COMBUSTION engineers have often discussed the possibilities of having central heating stations for supplying steam for the steam-pipe heating of buildings and flats. We learn that 45 miles of mains for this purpose have already been laid in New York, and that more than 7000 million pounds of steam are being sold yearly by meters. The steam is used in addition for electrical generation for lighting and for working lifts in office buildings. Many householders discard their furnaces and buy steam instead of coal. To produce this steam last year 350 thousand tons of the cheapest grades of anthracite and pulverised bituminous coal were used. Recent improvements in the main steam pipes, which carry large quantities of steam long distances, have made this method of supplying heat a rival to electric and gas heating. Somewhat similar methods are used on a smaller scale in other parts of the world.

The "Statistical Report of the Health of the Navy for the year 1924" has recently been issued (London: H M. Stationery Office. 4s. 6d. net.). The returns for the total force show a decrease in the incidence of disease as compared with the three years' average, but a slight increase in relation to 1923. The invaliding and death ratios also show a decrease in comparison with the three years' average. The Mediterranean Station showed the lowest sick rate, and the China Station the highest. Bronchial catarrh caused the largest number of cases (5641) of sickness, and influenza, 2407 cases. As in the Army, tonsillitis shows a considerable incidence with 2602 cases.

Prof Samuel J. Record, of the Yale School of Forestry, has presented to the Smithsoman Institution a valuable collection of plants illustrative of the flora of Honduras, one of the few regions in North or Central America which is still practically unknown botanically. In view of the lack of knowledge of the forest flora of Honduras, it is not surprising that study of the collection has revealed the presence of several new species, a genus new to North America, and several extensions of range. The collection includes many woods of economic importance, and it is probable that much information of value to the lumber industry will result from the study of the economic woods of Honduras which this collection makes possible.

WE have received a copy of the Index of the Faraday Society Transactions, vols. 1-20 (paper cover, 10s. 6d. net; cloth, 13s. 6d. net). The entries have been emphasised in such a way that quick reference is facilitated. For this reason the titles of the papers have in some cases been slightly altered in the Subject Index, hence, when original titles are required, reference should be made in the Author Index. It is obvious that great care has been exercised in compiling this publication, and it will undoubtedly prove very useful.

We have received the annual report of the Calcutta School of Tropical Medicine, Institute of Hygiene, and the Carmichael Hospital for Tropical Diseases for 1926. A history of the School is given, together with a summary of the past year's work and of the research work carried out, with a portrait of its founder, Sir Leonard Rogers.

THE British Drug Houses, Ltd., Graham Street, City Road, N.1, issues a useful booklet on the use of stams in bacteriology and pathology, with their formulæ, and a price list of standard microscopic stams. For those who only occasionally employ stams, small quantities of the solutions are supplied.

WE have received from Messrs. Baird and Tatlock, Ltd. (14-15 Cross St., Hatton Garden, E.C.1), vol. 3 of their "Standard Catalogue of Scientific Apparatus" (1927). This deals with the biological sciences, excluding physiology, to which vol. 2 is devoted. It contains a very full list of apparatus for teaching and research required in anatomy and microscopy, botany and zoology, bacteriology, pathology and hygiene, and

agricultural science. In addition to making apparatus in their own workshops at Walthamstow (of which several excellent plates are inserted), the firm also acts as agent for many individual makers of scientific instruments, e.g. microscopes and inicrotomes. The catalogue is extraordinarily complete, and an almost bewildering range of apparatus is listed. It is profusely illustrated, and being printed on paper with a good surface, the illustrations are very clear and distinct. Messrs. Baird and Tatlock also design and supply laboratory furniture and equipment.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned .—A registrar of the Wigan and District Mining and Technical College-The Principal, Wigan and District Mining and Technical College, Wigan (July 11) An assistant lecturer in botany at the University College of North Wales, Bangor-The Secretary and Registrar, University College of North Wales, Bangor (July 12). Junior assistants at the National Physical Laboratory for work in connexion with photometry and metallurgy -The Director, National Physical Laboratory, Teddington (July 16) An instructor for carpentry and joinery and building construction in the School of Building, Willesden-The Principal, Willesden Polytechnic, Priory Park Road, Kilburn, NW.6 (July 16). A lecturer in biology in the Edinburgh and East of Scotland College of Agriculture—The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh (July 18). A fulltime lecturer in the Department of Mechanical and Civil Engineering of Loughborough College—The Registrar, The College, Loughborough (July 18). A demonstrator in geology in the Queen's University of Belfast-The Secretary, Queen's University, Belfast (July 20). A lecturer in zoology at Armstrong College, Newcastle-upon-Tyne--The Registrar, Armstrong College, Newcastle-upon-Tyne (July 23). A senior lecturer in the Department of Electrical Engineering of Loughborough College-The Registrar, The College, Loughborough (July 23). A reader in organic chemistry in the University of Dacca, India-The Registrar, University of Dacca, East Bengal (July 30). A university lecturer in structural crystallography in the University of Cambridge-Prof. A. Hutchinson, Pembroke Lodge, Cambridge (July 31). A professor of chemistry in the University of Adelaide -The Registrar, The University, Adelaide, South Australia (August 15), or the Agent-General for South Australia, Australia House, 112 Strand, W.C.2 (October 1). A test assistant in the Metallurgical Department of the Royal Aircraft Establishment - The Chief Superintendent, R.A.E., South Farnborough, Hants (quoting A.193). A visiting lecturer in structural engineering, drawing, and graphics at the Borough Polytechnic Institute-The Principal, Borough Polytechnic Institute, Borough Road, S.E 1. A woman clinical pathologist at the Lady Hardinge Medical College, New Delhi, India-Dr. Kate Platt. 59 Queen Anne Street, W.1. A professor of medicine in the University of Edinburgh—The Secretary to the Curators, 4 Albyn Place, Edinburgh.

#### Research Items.

A Jaina Image of Ajitanâtha —In the Indian Antiquary for April, N. C. Mehta figures and describes a beautiful image of Ajitanâtha, according to tradition, a contemporary and cousin of the mythical prince Sagara. It was executed in A D. 1053, when Jamism, having suffered an eclipse in the south after the sixth century A.D., was approaching its climax in western India under the Solanki rulers of Gujarat. The image is 51 inches, or, with the pedestal, 63 inches in height. Judging from the exceptionally bright and yellow lustre of the body, the metal must contain a large amount of gold. It stands in the characteristic pose of a Jaina kevali, i.e. "one who has attained the Peace born of perfect knowledge and of absence of attachment to things mundane." The face is that of a young man, strikingly handsome, and the limbs are beautifully modelled and of pleasing proportions. The loin cloth is attached to an elaborately carved girdle of fine design. The ushnîsha, the symbol of enlightenment, is just indicated, while the Jewel of Illumination is prominently shown on the forehead. An inscription states that this statue was set up in memory of the saint Shâlıbhadra by his pupil Pûrnabhadra. The statue is still worshipped in the Ajitanâtha Temple in Zaverivâdâ at Ahmadâbâd. It is a very favourable example of the art of casting metallic images which reached a high standard in medieval Gujarat, and of which a large number of good specimens are still to be found in the Jama temples scattered throughout Gujarat and Rajputana.

Food and Habits of Meganyctiphanes.—An account is given by Mr. R. Macdonald (Jour. Marine Biol. Assoc., vol. 14, No. 3, March 1927, pp. 753-84) of work carried out in the Clyde area from the Marine Biological Station at Millport on the biology of this euphausiid, which is of great importance in the economy of certain fish, particularly hake and herring. He finds it to be a suspension feeder, subsisting on minute organisms and detritus. Vegetable detritus of land or coastal origin appears to be of special importance as a source of food in the area studied. Evidence is given of partial diurnal migration in a vertical direction, but further work seems to be required to establish the conditions of such movements. In the second paper, Mr. Macdonald describes certain irregularities in the larval development of M norvegica (vibid. pp. 785-94).

A FLAGELLATE IN A NEMATODE.—Dr. T. Goodey and Miss M. J. Triffitt (*Protozoology*, No. 3, 1927) describe observations on flagellates in the intestme of the nematode Diplogaster longicauda. This worm was living in numbers among decayed material from a narcissus bulb, and many of the worms harboured the flagellates in their intestine—in some cases the gut "was literally packed with them." The flagellates are  $10\mu$  to  $12\mu$  long, fusiform in shape, and have a single flagellum. Occasionally the flagellates issued from the anus of the worm into the fluid—material from the decayed bulb plus a little tap-water—and in some of them a contractile vacuole was seen to make its appearance towards the anterior end of the body, but a contractile vacuole was not seen in any of the flagellates still in the gut of the worm. The nucleus of the flagellate is of the vesicular type with large karyosome, the parabasal body is rod-shaped or oval, and there is a small anterior centrosome from which the axoneme takes origin. The free part of the flagellum is  $8\mu$  to  $12\mu$  long. Both leptomonad and crithidial forms were observed and division stages of both forms were seen. A Leishmania stage was not

met with. The flagellates agree with *Leptomonas* butschlin in general shape and size, but the authors prefer to leave open the question of the name of the organism.

GROWTH OF THE SKELETON IN TWO ECHINOIDS -Although much valuable research has been conducted on the embryology of sea-urchins, few workers have investigated the development of the skeletal plates from the embryo to the adult, and indeed the difficulty of rearing the forms in an aquarium has been a sufficient hindrance to any complete study. Fortunately, modern methods have at last enabled Prof. MacBride and his pupil Dr Isabella Gordon to obtain excellent series of a regular urchin, Echinus miliaris, and an irregular heart-urchin, Echinocardium cordatium, and very thorough and complete accounts of the development of the test have been published by Dr. Gordon (*Phil. Trans. Roy Soc*, B, vols. 214 and 215). Both memoirs contain valuable additions to our knowledge, but the latter lends itself better to summary here. While the adult heart-urchin has the outline which its name implies, with the apical system from which radiate five petal-shaped ambulacra, on the upper surface, with the mouth shifted to the front of the under surface, and with the anus at the other end of the body, the young as it emerges from the larval stage has an almost circular outline, with the mouth central on the under surface, and the anus enclosed by the central apical system, from which radiate ambulacra of primitive structure. Dr. Gordon traces in minute detail the shifting of mouth and anus and the gradual growth and specialisation of the ambulacra. For her statement of facts we have nothing but praise, but when she says that "the migration of the anus within the periproct is due to a difference in the rate of growth of the various plates, or that the periproct is encircled by the inter-ambulacrum "as a result of" the addition of inter-ambulacral plates, then we suggest that the alleged cause is merely a concurrent phenomenon. If anything, it is the tension on the gut as the body elongates that pulls down the anus; and the plate-building follows this.

SEISMOGRAPH RECORDS.—In the Issue of the Proceedings of the Imperial Academy of Japan for March, Mr. K. Suyehiro directs attention to the possibility of a seismograph installed so as to be sensitive to earth movements in a particular direction being set in motion by disturbances at right angles to those it is intended to record. He shows that an instrument set up, for example, to record movements in the north-south direction may be set in motion by an east-west movement of half the natural period of the instrument, and that the records of such an instrument are liable to misinterpretation on this account. The possibility of the motion of the instru-ment to which attention is thus directed, will be recognised by those who are acquainted with Melde's experiment, in which a stretched wire is set into transverse oscillation by one end of it being attached to the prong of a tuning-fork vibrating along the axis of the wire.

GEOPHYSICS IN FRANCE.—The Institut de Physique du Globe de l'Université de Paris, with which is associated the Bureau Central de Magnétisme Terrestre, under the directorship of M. Maurain, has recently published vol. 4 of its *Annales*. It gives an interesting and valuable record of the considerable activity which now exists in France in the investigation of

terrestrial magnetism and other branches of geophysics. It contains nineteen articles, of which the first and longest is the report of the Val Joyeux magnetic observatory, including tables of hourly values of the three elements, for 1924. A shorter report of the less comprehensive observations at Nantes is also given. The remaining articles on magnetism mainly refer to survey measurements in various parts of France, and also in Syria. Other sections deal with meteorology, seismology, and actinometry at Parc Saint-Maur, and with atmospheric electricity observations made on board the ship Pourquoi-Pas? in the Arctic region.

The Height of Iridescent Clouds.—In Geophysical Publication No. 2 of Volume 5, published by the Norwegian Academy of Science, Oslo, Prof. Carl Stormer gives the results of his measurements of the heights of iridescent or mother-of-pearl clouds. His method is to take simultaneous photographs of the clouds from two distant stations at a time when some of the brighter stars will show on the plates. The altitude of the cloud can then be calculated from its parallax. From observations taken at stations 26 kilometres apart during the evening of Dec. 30, 1926, he finds the altitude to be 27 kilometres.

CAUSES OF TROPICAL RAINFALL —The rainfall of the Sudan, both west and east, has been found to fluctuate considerably from year to year, not in-frequently to such an extent that deficiency or irregularity leads to famine. In discussing the causes for this in a paper in Matériaux pour l'étude des calamités (No. 11, 1926), Mr. G. T. Renner maintained that all tropical rainfall is really monsoonal in character During the period of high sun, the land masses are centres of low pressure surrounded on sea and land by areas of higher pressure. Monsoonal currents blowing from the sea into these areas of low pressure bring heavy rainfall. The alternate cooling of the tropical lands, when the sun is low, leads to a high pressure and a dry season. The double rainy season of equatorial regions is caused by those areas being crossed by both sets of monsoonal currents. variations in the rainfall of the Sudan are due to variations in the intensity of the low pressure and the resultant strength of the monsoon currents. Variation in solar weather must cause the variation in the intensity of the low pressure. Mr. Renner further points out that while all tropical rainfall is liable to vary from year to year, it is only in the savanna and grassland regions, where normal rainfall makes agriculture just possible, that a marked deficiency leads to famine conditions. He thus considers that all the tropical savannas and grasslands are potential famine areas.

The Sensitive Centres of Silver Bromide Particles.—It is well established that in the development of an exposed gelatino-bromide plate the reduction of the silver salt to metal (the blackening), starts at 'centres' or points on the crystals or particles of the silver salt. It is generally assumed that these points where the action begins are more sensitive than the rest of the crystal or particle Dr. S. E. Sheppard has found that this sensitiveness is caused by certain sulphur-containing organic bodies present in the gelatin, and considers that the extra sensitive points are invisibly small specks of silver sulphide. The existence of these centres or starting-points of action has been demonstrated by stopping development at a very early stage, before the reduction has had time to extend to the whole particle. Messrs. Sheppard, Trivelli, and Wightman now find (Journal of the Royal Photographic Society, June 1927) that the

existence of these centres may be shown also by 'printing-out,' that is, merely prolonging the exposure by subjecting the plate to the action of an intense beam of white light for four minutes. They find, too, that by soaking a plate for one hour in a very dilute solution of allylthiourea and then for five minutes in a 1 per cent. solution of sodium carbonate, a number of black specks appear that were not there before. They "feel safe in saying" that these black specks are formed by the transformation of invisible specks of allylthiourea-silver bromide into silver sulphide. The communication is illustrated with excellent photographs which clearly show the results stated

PHOTOCHEMICAL EQUILIBRIUM IN NITROGEN PER-OXIDE.—In the course of some photochemical investigations, R. G. W. Norrish noticed that nitrogen peroxide enclosed in a water-jacketed vessel and illuminated by the rays from a quartz mercury vapour lamp showed a considerable increase of pressure, which was too great to be attributed to the heating effect of the absorbed light. The experiments which have been carried out in order to determine the cause of this pressure change are described in the April issue of the Journal of the Chemical Society. It has been found that the establishment of a photochemical equilibrium between nitrogen peroxide and nitric oxide and oxygen is the chief cause of the increase of pressure. To this must be added the direct heating effect of the absorbed radiation, and the effect of the heat liberated from the reverse reaction  $2NO + O_2 \rightarrow$ 2NO<sub>2</sub>. A reaction mechanism is suggested which is capable of giving results in quantitative agreement with those determined experimentally.

The Celorides of Sulphur.—Although the evidence as to the exact nature of the chlorination products of sulphur is somewhat contradictory, it is generally agreed that a monochloride and a tetrachloride exist, and that the so-called 'dichloride' is merely a mixture of these two. This conclusion is largely based on cryoscopic experiments, and in the Journal of the Chemical Society for April, Lowry, M'Hatton, and Jones describe the results of a careful redetermination of the freezing-point curve of the chlorides of sulphur over the range from 16-70 per cent. of sulphur. This re-determination has revealed, in addition to the main sections corresponding to the separation of the monochloride and the tetrachloride, two well-defined breaks which are attributed to the crystallisation of the dichloride and of a trisulphur tetrachloride of the formula S<sub>3</sub>Cl<sub>4</sub> which has not been prepared before. It is proposed to discuss the molecular structure of these compounds in a later paper.

COKING PROPERTIES OF COAL.—One branch of the work of the Fuel Research Division is the physical and chemical survey of British coal seams. Dr. J. T. Burdekin, of the South Yorkshire Survey Staff, has published an investigation of the caking power of coal (Fuel Research Survey, Paper No. 8. London: H.M. Stationery Office. 1s net). Numerous attempts have been made to give a quantitative figure to the tendency of a coal to produce a coke on carbonisation. So many factors operate that a single simple test is difficult to find. The author has carbonised different mixtures of the coal with calcined anthracite at defined and various rates of heating, and determined the crushing strength of the product in a special machine. The results are displayed as 'caking power curves' (crushing strength against composition of coalanthracite mixture), and it is believed that these curves can be interpreted as giving a measure of the capacity of a fuel to give a satisfactory coal in an oven.

. . . .

## The Expedition of the Meteor in the South Atlantic.

THE third report 1 on the progress of the Meteor Expedition, of which an account was given in NATURE of Jan. 1. includes some interesting results of an extensive survey of the chemical and physical conditions of the waters of the South Atlantic.

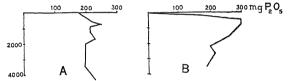
Water cooled below the Arctic ice in the northern hemisphere falls and creeps slowly southward as a deep current, rising in the zone 50°-60° S. and turning back to flow as an intermediate current at a depth of between 500 metres and 1000 metres towards the equatorial zone, where it mingles with the upper layers A similar type of circulation was recently found in the Indian Ocean by Schott 2

The estimations of dissolved phosphate made on

this expedition are singularly interesting as a factor governing the fertility of the ocean, for the conclusions based on them by Wattenberg are in excellent agreement with the conclusions arrived at by Atkins<sup>3</sup> from

Mean latitude	55° S	48° S	42° S	35° S	28° S	23° S	15° S	10° S	3° S	2° N.
Plankton organisms per litre at 200 metres	1528	1415	302	718	171	695	443	600	747	702
Plankton organisms per litre at 1000 metres	71	29	34	49	19	28	24	55	62	62

his work in the North Atlantic and around the coasts of Britam. In the tropics the sudden increase of phosphate with depth is accounted for by its utilisation in the surface layers by vegetable plankton



1—Vertical distribution of dissolved phosphate in the South Atlantic Abscissæ show milligrams  $P_2O_5$  per cubic metre, ordinates depth in metres  $A:\ ca\ 50^\circ\, S.$ , B. Tropics. Fig. 1

organisms; here the sudden difference in density between the light warm upper layers and the cold heavy water below hinders mixing by means of convection currents, whereas in more southerly latitudes the upper layers, nearer in density to the water below, are continually being renewed by this means, giving rise to much greater plant growth.

<sup>1</sup> Die Deutsche Atlantische Expedition auf Meteor. Bericht 3 Zeitsch der Gesells für Erdkunde zu Berlin, 1927.

<sup>2</sup> Ann der Hydrog, 54, 417-431, 1926

<sup>3</sup> Jour Marine Biol Assn., 13, 119-150, 700-720, 14, 447, 1923-1926

NATURE, 116, 784, 1926

On the West African coast, water rising from the depths continually enriches the surface layers and occasions a rich growth of plankton A considerable fouling of the ship's bottom in this area was also noticed, and it was observed that the colour of the sea was modified by the greater number of plankton organisms in it, which by reflecting yellow and green light give it a greenish blue appearance on looking down over the ship's side

A table by Hentschel shows the average number of indıvıdual plankton organisms per litre found during the course of the ten cruises already made across the ocean, and brings out very clearly the relation of fertility of the water to latitude

The minimum of life does not occur in the equatorial region but around latitude 28° S., in the region corresponding to the Sargasso Sea in the North Atlantic, where warm surface water forms a pool in the ocean.

In this connexion it is interesting that Lohmann 4 m the Deutschland found more plankton in the equatorial region than in about 20° N. The explanation in both cases seems to be that water rich in phosphate and nitrates rises near the equator to take the place of that which flows away in the westgoing currents, whereas immediately north and south of this zone the upper layers are not enriched from below to any appreciable extent and plant life is reduced to a minimum, giving rise to the barren deep blue areas of the oceans.

Estimations of alkalinity of the water in the tropical regions indicated that the surface layers were to a slight extent depleted of dissolved calcium carbonate through the agency of minute plant organisms which secrete an enveloping shield of calcareous plates, while the water close to the bottom was somewhat richer than the intermediate layers owing to solution of calcium carbonate from the detritus of dead organisms. Sea water generally is almost, but not quite, saturated with respect to calcium carbonate.

4 Arch. fur Biontologie, 4, Heft 3. Berlin, 1920.

## The Gas Industry and Carbonisation.

TINDER the presidency of Mr. J. Wilkinson, of Nottingham, the Institution of Gas Engineers held its annual meeting in London on June 14-16. Mr. T. Carmichael discussed the economics of carbonisation as based on operations of the Portsmouth Gas Company, where a wide range of plant is at work. The cost of production of gas in vertical and horizontal retorts showed no great difference and is only half that of the cost of producing carburetted water gas. There is then no incentive to produce gaseous fuel from oil at the present time, so far as cost of production is concerned. Mr. G. M. Gill described types of modern chamber ovens and coke ovens and discussed their suitability as carbonisation units for gas-works purposes. Mr. T. Canning devoted a paper to the relations of a gas undertaking to its con-The pre-carbonisation of coal before combustion is to-day kept constantly in the public eye. The town's gas industry is carrying out such processes under strictly commercial conditions, and is the

only industry doing so on a national scale. Its results and experiences as indicated by these papers deserve close study by all advocates of coal carbonisation.

The progressiveness of the industry is indicated by the great space devoted to the various reports on research. The Gas Research Fellow's report of a study of the properties of coke prosecuted at the University of Leeds contains more observations on the remarkable influence of morganic catalysts on the gasification of coke in steam, carbon dioxide, and oxygen. Sodium carbonate is again shown to have a farreaching effect on these reactions. An interesting experimental technique is described for studying the reactivity of carbon with oxygen which, owing to the great evolution of heat, has been a very difficult matter. In the eighteenth Report of the Joint Research Committee with the University of Leeds, an account is given of studies of the carbonisation process as applied to 30 lb. charges. The rôle of sodium carbonate, which had been demonstrated on

the laboratory scale, has been confirmed on 30-lb charges and a striking increase in the production of gas was shown, doubtless owing to the decomposition of water vapour present by the carbon, stimulated

by the presence of the soda.

The seventeenth Report of the same Commuttee gives a continuation of the study of the products of combustion of gas fires. In order to do this, it was necessary to develop and revise the method of determining carbon monoxide to deal with the minute traces which here require measurement. It was considered possible to do this with a precision of 1 part in a million. It was also established that carbon monoxide is always present in a city atmosphere in quantities reaching 6 parts per million under normal conditions, and in foggy weather reaching 25 parts. In association with the British Refractories Research Association, the Institution of Gas Engineers supports a wide range of experimental work which was reported to the meeting.

## University and Educational Intelligence.

BIRMINGHAM.—The Charter has been revised so as to embody alterations and additions the desirability of which has been suggested by experience. The chief points are: (1) Alterations in the titles of officers of the University. The "Vice-Chancellor" becomes "Pro-Chancellor," and the "Pro-Vice-Chancellor" becomes "Deputy Pro-Chancellor." The "Principal" becomes "Vice-Chancellor and Principal" and the conferring of degrees will be one of his functions. (2) The appointment of the Vice-Chancellor and Principal is to be made by the Court of Governors, on the recommendation of the Council, who shall have consulted the Senate. The appointment was formerly made by the Crown (3) The Guild of Graduates will elect a representative on the Council, and the non-professorial staff will elect from its number one member of Council and six representatives on the Court of Governors. (4) Power has been granted to create a Faculty of Law. The revised ('harter has been approved by the King in Council.

OXFORD.—The Board of the Faculty of Physical Sciences has appointed Mr. Bertram Lambert, follow of Merton College, to be Aldrichian demonstrator in chemistry for four years from the first day of Michaelmas term, 1927.

St. Andrews.—At the graduation ceremonial on June 28, the honorary degree of LL.D. was conferred (in absentia) upon Prof. John Rankine Brown, of Victoria College, Wellington, New Zealand. The degree of D.Sc. was conferred upon W. S. Duke Elder for a thesis on "The Nature of the Intraocular Fluids and the Pressure Equilibrium in the Eye," and on David Stiven for a thesis entitled "A Study of the Phosphatese-Phosphatase System of Muscle Extract."

THE University of Maryland has conferred the honorary degree of Doctor of Science on Sir John Russell, Director of the Rothamsted Experimental Station.

THE degree of Doctor of Science has been conferred by Columbia University, New York, on Frank B. Jewett, vice-president of the American Telephone and Telegraph Company, and president of Bell Telephone Laboratories, New York. In conferring the degree, President Butler referred to Dr. Jewett as "bringing to the art of telephony and its development the full weight and power of modern scientific knowledge; building on this foundation a notable organisation of

research workers and applied scientists, and thereby contributing in highest degree to the perfection of the art of communication between human beings and over increasing distances."

In a letter in the Times Educational Supplemen for May 28, the chairman of a special committee of the Science Masters' Association directs attention to the strange diversity in the attitude taken up by different universities with regard to the recognition of advanced courses in science in secondary schools. While exact uniformity may not be essential, there seems to be a danger that the progress of scientific education may be hampered in certain areas owing to the policy of the local university; Oxford and Cambridge show their appreciation of the advanced courses by granting certain excimptions to students who have passed the higher certificate, and their influence, fortunately, is not confined to any particular locality. The last year at school is often of supreme importance in the formation of the mild and character of a boy; if injudicious pressure is brought to bear upon him to leave school and enter on a career of narrow specialisation at too early an age, the boy himself may never attain to his full mental stature, the university will receive less competent students, the standard of science teaching for all boys in the school will be depressed and the status of science relative to other subjects will mevitably suffer.

THE increase in recent years in the demand for higher education and in its cost is shown in a recent publication by Mr. A. J. Klein, Chief of the Division of Higher Education, Bureau of Education of the United States ("Higher Education Biennial Survey, 1922-1924" (Bulletin, 1926, No. 20); Washington, D.C.: Government Printing Office). For example, in 1912 there were 255,673 students enrolled in the colleges and universities of the United States, in 1922 the number had become 550,906. The meome of higher institutions in 1912, excluding additions for endowment, was 90 million dollars; by 1922 if had risen to 273 million. This increase is far greater than the increase in population or in the income of the country. The additional money has been largely used in increasing teachers' salaries. In small colleges salaries have risen from an average of about 1400 dollars to an average of 2000; in medium-sized institutions from 2500 dollars to 4000; in large institutions from 5000 dollars to 8000 or 10,000. The number of members of staff increased from 30,000 in 1912 to 50,000 in 1922. There has been much criticism of the products of higher education. There is a general demand that those who enjoy its benefits should contribute more largely to its cost. Everywhere there has been a tendency to increase tuition and institutional fees, but this has had little effect in reducing the number of students. measures have been adopted with the view of restricting admission to those who are most likely to benefit from a university training; e.g. Harvard has limited its entering class to 1000 and changed its entrance requirements; while the personal interview has also been used. The junior-senior high-school system is being modified with the view of providing completion courses for those who are not proceeding to college. "The burden upon the [university] institutions makes them friendly towards the idea of developing separate two-year junior colleges," which will (1) provide a liberal arts course leading to entrance to the 'junior year' in a university, i.e. skipping the freshman and sophomore years; (2) conduct two-year professional or pre-professional courses; (3) offer twoyear completion courses for those who do not desire to secure a degree or enter a profession.

## Calendar of Discovery and Invention.

July 10, 1817.—For his important discoveries on the polarisation of light, Brewster in 1815 received the Copley Medal. In his investigations he was led to the invention of the simple scientific apparatus, the kaleidoscope, which he patented on July 10, 1817. As a toy the kaleidoscope quickly gained immense popularity in England and America. Writing from London in May 1818, Brewster said, "You can form no conception of the effect which the instrument excited in London. . . . Infants are seen carrying them in their hands, the coachmen on their boxes are busy using them, and thousands of poor people make their bread by making and selling them"

July II, 1861.—Kirchhoff's great paper "On the Solar Spectrum," containing his views of the true nature and the chemical constitution of the sun from his interpretation of the Fraunhofer lines, was read before the Berlin Academy of Sciences on July 11, 1861. To no one did Kirchhoff's work appeal more than to Huggins, who years afterwards wrote: "This news was to me like the coming upon a spring of water in a dry and thirsty land. Here at last presented itself the very order of work for which in an indefinite way I was looking—namely, to extend his novel methods of research upon the sun, to the other heavenly bodies."

July 12, 1770.—The spinning jenny constructed by Hargreaves and patented by him on July 12, 1770—an epoch-making invention—has been described as "the instrument by which (so far as we have any authentic and trustworthy evidence) the human individual was first enabled, for any permanently advantageous and profitable purpose to spin wool, cotton, or flax into a plurality of threads at the same time and by one operation."

July 12, 1771.—On this day H.M.S. Endeavour anchored in the Downs, after her three years' voyage round the world under the command of James Cook. In 1769, observations of the transit of Venus had been made, and this was followed by the circumnavigation of New Zealand and the survey of the Great Barrier Reef of Australia.

July 12, 1796.—In a letter to Sir Joseph Banks, dated July 12, 1796, Rumford offered £1000 to the Royal Society "to the end that the interest of the same may be by them and by their successors, received from time to time for ever," and the amount applied every second year as a premium to the author of the most important discovery which shall be published in any part of Europe during the preceding two years, on heat or on light.

July 13, 1897.—After his demonstrations in Bologna in 1895 and in England in 1896, Marconi, at the invitation of the Italian government, made experiments at Spezia, where, on July 13, 1897, radio messages were sent between a land station and Italian warships over a distance of 12 miles.

July 15, 1662.—The beginning of the "Royal Society of London for Improving Natural Knowledge" dates from July 15, 1662, when the first charter passed the Great Seal. Weld in his history says: "The first Charter is on four sheets of Vellum; it was drawn by Sir Robert Sawyer, then Attorney-General, and is remarkable for its cleamess and legal terseness; the first sheet contains some remarkably handsome ornamental capitals and flowers, with a finely executed Portrait of Charles II. in Indian Ink with the initial letter C. The Great Seal of the Kingdom in green wax is appended to the Charter."

#### Societies and Academies.

LONDON.

Royal Society, June 30.—A. V. Hill, K. Furusawa, and J. L. Parkinson. The dynamics of 'sprint' running. By an application of the theory of dimensions it is shown that the speed of an animal, such as man, is limited by the inertial stresses to which the structures are subjected during movement. The 'viscosity' of the muscles is the chief factor. For experimental work it is necessary to employ maximal contractions. The case of submaximal contractions is theoretically discussed. A runner exerting maximal effort propels himself with constant force. The 'constants' of a given runner can be determined with very fair accuracy, and the work done, in running, against viscosity and resistance of the muscles can also be determined.

A. V. Hill, K. Furusawa, and J. L. Parkinson: The energy used in 'sprint' running. The mechanical work done against the viscous resistance of the muscles of the runner has been compared with the amount of oxygen used in recovering from the effort. The result shows a 'mechanical efficiency' of about 38 per cent. In a man running 200 yards, at top speed throughout, fatigue begins to appear after 70 yards, and by the end the speed has fallen by about 12 per cent. This fatigue is due to the enormous rate of expenditure of energy in running at top speed; one subject, who ran his first 100 yards in 9.88 sec., and his second in 9.57 sec, developing 8½ horse-power at his maximum velocity (11.46 yards per sec.) and liberating 4 gm. of lactic acid per sec. in his

R. G. Canti and F. G. Spear: The effect of gamma irradiation on cell division in tissue culture in vitro. The extent of inhibition of mitosis was determined by making counts of the total number of cells undergoing mitosis and expressing these counts as percentages of the total number of cells undergoing mitosis in the same number of unirradiated cultures of the same batch used as controls For a given intensity of irradiation, there is a period of time of exposure which must be exceeded before any change in the number of cells undergoing mitosis is observed, and after this minimum time is passed the effect upon mitosis is sudden and well marked. Under the conditions of experiment, a longer time is required to bring about this biological effect with weaker intensities than would be expected from the physical determinations, and there is a minimum intensity of irradiation below which no such effect takes place.

A. N. Richards and J. B. Barnwell: Experiments concerning the question of secretion of phenosulphonephthaleme by the renal tubule. Phenol red applied to the surface of a decapsulated rabbit's or frog's kidney passes into the urine eliminated by it. When salt solution is made to flow from the ureter through the tubule to the capsule of Bowman, during perfusion of the renal portal system with phenol red solution, phenol red can be identified in the saline collected from the capsule. Complete obstruction of the circulation through the glomerulus does not prevent phenol red from entering the tubule and becoming concentrated there. When an excised frog's kidney is immersed in oxygenated phenol red solution, the dye passes into the tubule and becomes concentrated. These facts, which present the appearance of secretion of phenol red by tubule cells, are best explained by assuming diffusion of water and dye into the tubule at one level, active extrusion of water and retention of dye at another, and a fluid current within the tubule from one level to the other.

S. B. Schryver and H. W. Buston The isolation of some undescribed products of hydrolysis of proteins (Part iv.). When gelatin is hydrolysed rapidly with sulphuric acid, it yields about 20 per cent. of its introgen in the form of diamino-acids; if, however, the gelatin is allowed to stand with acid in the cold for a day before hydrolysis, the diamino-acid content is increased to about 29 per cent. This increase is due mainly to the formation of dl-lysine; at the same time there is a slight increase in the amounts of arginine and active lysine. The dl-lysine is not formed by mere racemisation of active lysine, but must be formed from some precursor which only yields the base by the action of cold acids.

J. B. Cohen, with others. The therapeutic action

J. B. Cohen, with others. The therapeutic action of some bismuthyl derivatives of organic hydroxyacids. The therapeutic action of several of these substances on Spirochæta Laverani has been investigated. The action depends not only on the bismuth content, but also on the chemical constitution of the product under investigation, so far as the effect on mice infected with Sp. Laverani was concerned. The effect of bismuthyl saccharic acid and its sodium salt has been tried in human subjects, but these substances possess no great advantage over the bismuth preparations in general use. The main fact emerging from a chemical study of the bismuthyl series is the greater reactivity of esters over the corresponding

hydroxy-acids.

T. S. P. Strangeways and Honor B. Fell: A study of the direct and indirect action of X-rays upon the tissues of the embryonic fowl. The destructive effect of a given dose of X-rays upon the tissues of an embryo is correlated with the age of the embryo irradiated. With the exception of a relatively small number of cells destroyed by the direct action of radiation, the death of the tissues in 6-day embryos is due to an indirect action. There is no evidence that the cells qua cells of a 6-day embryo are more susceptible to the action of X-rays than those of a 20-25-hour embryo. The degenerative changes induced in the tissues of 6-day embryos by X-rays are intimately related to cell metabolism, since they are inhibited or greatly retarded when metabolism is arrested by low temperatures. The lethal action of X-rays is not due to the formation of stable toxic products

C. M. Yonge: Structure and function of the organs of feeding and digestion in the septibranchs, Cuspidaria and Poromya. The septibranchs are carmivorous and specialised for taking in and digesting large food particles, which, with water, are drawn in by the action of the septum, a highly muscular organ, striated in Cuspidaria, but not in Poromya. passes from the infra-septal cavity into the supraseptal by way of fine pores in Cuspidaria, and by two pairs of branchial sieves in Poromya. Labial palps are small, ciliated on inner side, muscular; they push food into the mouth. All clia in infra-septal cavity carry particles away from mouth, either into supraseptal cavity or to posterior end of infra-septal. The œsophagus is wide and muscular, stomach long and cylindrical, lined throughout with thick cuticle, muscular and free from surrounding tissues; it acts as a gizzard. The digestive diverticula have unusually short and wide ducts and the tubules provide the only absorptive surface in the gut All modifica-

tions of gut appear correlated with the type of food.

B. K. Das: The bionomics of certain air-breathing fishes of India, together with an account of the development of their air-breathing organs. The post-larval development of the air-breathing organs in six genera of air-breathing fresh-water fishes, namely, Claries, Saccobranchus, Anabas, Ophio-

cephalus and Amphipnous, is described. In Anabas and Macropodus the organ consists of an air-chamber, or secondary lung, situated on either side of posterior region of head, each of which lodges three vascular shelly labyrinthiform plates; in Clarias there are two vascular tree-like structures made the air-chamber; Saccobranchus has a long tubular lung-like structure extending back from the gill chamber to the sides of body; Ophiocephalus has a vascular air-chamber situated on each side of head, whereas in Amphipnous there are two large 'bladders' resombling amphibian lungs and extending to a short distance behind the head.

(To be continued.)

Royal Anthropological Institute, June 14.—Sir Baldwin Spencer. Recent researches amongst the Arunta with special reference to the Alchera and Churinga beliefs. The chief features of the earlier work of the late F. J. Gillen and the author were (1) the demonstration of the fundamental importance of group relationship in regard to social organisation of the tribes, the existence of which in Australia had first been shown by Howitt and Fison, (2) the complex development of the totemic system and of the customs and beliefs associated with this; and (3) the existence of a theory of conception related to a belief in an ancestral spirit individual who voluntarily and without any necessary relation to natural processes reappeared in successive incarnations. The Rev. C. Strehlow, in charge of a Mission Station amongst the Arunta, has arrived at conclusions in regard to the significance of the Churinga and, more especially, of the Alchera belief, which are different from these. Recent inquiries have confirmed Spenser and Gillen's original account, so far as it went. The term Alchera is of somewhat vague and wide import. It is associated in the native mind with the far past times in which his ancestors came into existence, lived and died. Every individual has his, or her, Alchera. Its use by missionaries as the equivalent of god is wrong and misleading. The Churinga belief, according to which the spirit part of every individual is associated with one of these sacred slabs of stone or wood, is fundamentally as Sponsor and Gillen described it. A great leader, Numbakulla, who appears in various forms in tradition, originally made everything. The original Churinga were split into two, with one of which a male and with the other a female spirit became associated. When the Alchera ancestor died his spirit part also split into two, one forming an everlasting Arumburinga, the other a Kuruna that continually undergoes re-incarnation.

## MANCHESTER.

Literary and Philosophical Society, May 10.—A. Lapworth and E. N. Mottram: A survey of direct and collateral evidence bearing on some stereochemical inversions and cross-saturation processes. Bedo's view (Compt. rend., 183, 750, 1926) that the oxygen atom in cyclohexeneoxide lies in the plane of the cyclohexane ring is not accepted. The theory which appears to be most nearly consistent with collateral evidence is that in each of the three steps: (1) cyclohexene to cyclohexene - halogenhydrin, (2) -halogenhydrin to cyclohexene - halogenhydrin, (2) -halogenhydrin to coxide, and (3) -oxide to -glycol involves a 'cross-reaction,' this term being used to include both 'simple stereochemical inversions' (such as, for example, the Walden inversion) and trans- or cross-addition processes. Oxidation of ethylenic compounds by means of permanganate is known to lead, in effect, to cisaddition of 2OH groups, whilst oxidation by hydrogen and other peroxides similarly leads to trans- or cross-addition. The authors criticise theoretical treatment

of the subject by Hilditch (Trans. Chem Soc., 129, 1830; 1926 et seq.), and by Boesekin and Belinfante (Rec des Travaux Chimques, 45, 917, 1926), as the glycols obtained from an ethylenic compound by cis- or trans-addition are, so far as is known, equally closely related to the original compound: they agree, however, with the authors last named in holding that, contrary to the views of Hilditch (loc cit.), there is no evidence of any inversion when permanganate is used, but that a stereochemical inversion probably does occur at the breakdown of ethyleneoxides formed as intermediate products when peroxide is used

#### Paris

Academy of Sciences, May 30 -Ch Barrois, Paul Bertrand, and Pierre Pruvost The coal measures of The principal result of the palaeoutological study of this field is the exact connexion of the veins opened up at Anzın with those of the western end of the Pas-de-Calais, on one part, and with those of Bormage, Limbourg, and the Ruhr on the other part. Moreover, for the first time, the thickness of the Westphalian series at the Belgian frontier can now be fixed.—E L. Bouvier · The Saturnia of Africa -The regulation of governors with André Blondel direct control furnished with dampers.—Léon Guillet: The addition of nitrogen to steels. Measurements of the hardness changes produced in various types of steel by the addition of nitrogen. The effects of various reagents on these steels were also studied .-Ph. Glangeaud. The origin of the fumarole mineral springs of Royat (Puy-de-Dôme).—Jean Effront . The synthesis of proteins by the saccharomycetes. In the course of the anaerobic life of yeast, the part of the sugar which serves for the synthesis of the proteins undergoes a preliminary decomposition without any carbon dioxide being given off and the whole of the carbon in the sugar remains in the yeast produced. If, on the contrary, the solution is strongly aerated, a certain quantity of the sugar is completely burnt and the sugar remaining is transformed into acctaldehyde, which furnishes the carbon for the synthesis of the proteins—Charles Nicolle and Charles Anderson. The resistance of the pig to the virus of Spanish recurrent fever and the natural conditions of existence of this disease and of other spirochætoses.—Paul Helbronner was elected membre libre in succession to the late Haton de la Goupillière.—S Mandelbrojt · A particular class of integral series.—S. A. Gheorghiu: The growth of the denominator  $D(\lambda)$  of Fredholm. Eugène Selivanowski · A class of ensembles defined by an enumerable infinity of conditions.—Basile Demtchenko: The stability of cavitations.—R. Swyngedauw: The reinforcement of the tension of The stability of cavitations.—R. a belt by the fact of its being wound on the pulley.-Emile Henriot: The resolution into two of a ray of light by the passage through a bent transparent plate. If a beam of light from a collimator falls on a bent plate with parallel faces, it is split up into two bundles, which, received in a telescope, give two images of the slit. If n is the refractive index before deformation,  $n_o$  and  $n_e$  the ordinary and extraordinary indices after deformation, it has been proved that  $n(n_o - n_e)/(n^2 - 1)^2$  is independent of the wave-length. This is in agreement with Havelock's law.—G. Balasse: Continuous spectra obtained by the electrodeless discharge in mercury vapour. From the experimental results described it is concluded that passing from a state of ionisation p+1 to a state of ionisation p, this passage is accompanied by the emission of a continuous spectrum, and this is a certain criterion of this passage.—Mlle. St. Maracineanu: Researches on the radioactivity of lead which has been submitted for a long period to solar radiation. Experiments carried out on the leaden roof of the Meudon Observatory prove that this lead, after prolonged exposure to the sun, possesses radioactivity. -Deslandres. Remarks on the preceding communica-These experiments probably prove the emission ot a special radiation (possibly ultra X-rays) which is capable, by a kind of phosphorescence, of modifying the radioactivity of bodies or even of causing it. A repetition of these experiments by other persons and in other places is desirable.—Joliot · A new method of studying the electrolytic deposit of the radio-elements. The electrode on which the substance is being deposited forms part of the wall of the electrolytic vessel and is sufficiently thin to be traversed by the radiation of the active body deposited. The radiation, liberated through the window thus formed, enters an ionisation chamber. The corresponding saturation current is proportional to the quantity of the active body deposited—Victor Lombard. The permeability of nickel to hydrogen—The influence of the thickness of the metal An experimental verifi-cation of the theoretical formula of Richardson, according to which the diffusion of gas through a metal is inversely proportional to the thickness of the metal.—Lespieau. The acetylenic crythrite

 $CH_2(OH) \cdot CH(OH) - C \equiv C - CH(OH) \cdot CH_2(OH)$ .

E. E Blaise and Herzog: The constitution of the chlorides of the α-acetoxyacids.—Max and Michel Polonovski: β-Pyridyl-α-pyrrilodine (normicotine) — Mile Jeanne Lévy and M. Sfiras: The isomerisation of some ethylene oxides of the general formula  $C_6H_5$ — $CH=CH_2$ .—Marcel Sommelet: The

N-alkylimines of benzophenone.—Louis Besson: The cooling of the air at sunset. Starting with twenty years' observations at the Montsouris Observatory, an empirical formula is developed giving the lowering of temperature three hours after sunset as a function of the temperature of the air and the pressure of aqueous vapour in the air —F. X. Skupienski: The evolutive cycle in *Didymium difforme*. Cytological study — E. Fleurent The composition of fenugreek seed and the inconveniences of its admixture with wheats intended for grinding -Maurice Fontaine: The mode of action of high pressures on the tissues.-Mme L. Random and R. Lecoq The evolution of avitammosis B in its relations with the constitution of the glucides m the food —Georges Bourguignon and Mile. Renée Déjean: Normal chronaxy of the vestibular nerve in man .- Javillier, H. Allaire, and Mlle. S. Rousseau: Nucleic phosphorus, phosphorus balance, and ratios in the course of growth -M. and Mme. Enselme: Contribution to the chemistry of cancerous tissue cancerous tissue there is a notable increase in the nucleic phosphorus compared with the amount of phosphorus in the healthy tissue. Irradiation with ultra-penetrating rays tends to make this excess of phosphorus disappear.—Constantin Gorini: Pathogenic bacteria, mixed ferments of milk.—Raoul The mechanical element, decompression, and the biochemical element, hypo-oxygenation, in the genesis of pulmonary or blood lesions in animals in rarefied atmospheres. Experiments on rabbits in which the effects due to lack of oxygen and those due to low pressure could be examined separately.—G. Mouriquand, A. Leulier, and P. Sedallian The diphtheric toxin and adrenaline of the suprarenals.

## VIENNA.

Academy of Sciences, April 28.—A. Muller and A. Sauerwald: The action of p-toluol-sulphamide on 1, 4-dibrom-n-butane and a new synthesis

of pyrrolidin -H. Suida and H. Proll: The composition of acetone oils.—P. Gross: The heat of dilution of electrolytic solutions.—W. J. Muller and E. Noack: The passivity of chromiun.—B. P. Wiesner: The sexual cycle of the rat (v.). The secretion pause during the interval.-L. Schmid and G. Bilowitzki: Communications on inulin (III.). Piperidin was used as a solvent to determine molecular weight by boiling-point methods.—F. Sigmund and G. Marchart: The behaviour of aldehyde-acetals during hydration after the method of Sabatier and Senderens.—R. Dworzak and P. Pfifferling: Studies on a-brom- and oxyaldehyde.—O. Koller and K. Lohberger. Fish from the Thian-Shan.—M. Holly: Siluridæ, Cyprinodontidæ, Acanthopterygiæ, and Mastacembelidæ from Kamerun.—J. Kozeny: Capillary conduction of water in the ground, its rise, oozing away, and application to irrigation —A. Paltauf: The colouring of living cell nuclei. Experiments with weak erythrosin solution on onions and with eosin on dahlıa. Salts of magnesium and potassium favour intake of colour .-- R. Andreasch. On acetoguanamın-sulphonic-acıd and related bodies. — F. Werner and others: Miscellanea Sudanica, being part xxiv. of the scientific results of a zoological expedition to the Anglo-Egyptian Sudan. - G. Kırsch and H. Pettersson: Atomic disintegration by a-particles. (v.) On the question of the existence of atomic fragments of short range. (vi.) The disintegration of carbon.
The fragments from carbon, at least in a large part, are hydrogen particles.—G. Stetter: Determination of the quotient, charge over mass, for atomic fragments from carbon, boron, and iron.—R. Holoubek: The detection of atomic fragments by the Wilson method.—E. Kainradl: Contributions to the biology of Hydrolea spinosa, with special consideration of the pericarp and seed development. The epithelial cells are a food store. A typical light germinator.

## Official Publications Received.

#### BRITISH

The National University of Ireland. Calendar for the Year 1927. Pp. vin+326+428+178. (Dublin.)

Memoirs of the Asiatic Society of Bengal Vol. 8, No. 6: Chemistry in 'Iraq and Persia in the Tenth Century A.D. By Il. E. Stapleton, the late R. F. Azo, and Prof. M. Hiddyat Husain. Pp. 315-417 5.1 rupees. Vol. 9, No. 3 Geographic and Oceanographic Research in Indian Waters By R. B. Seymour Sewell Pp. 51-129. 2.13 rupees. (Calcutta.)

rupees. Vol. 9, No. 3 Geographic and Oceanographic Research in Indian Waters By R. B. Seymour Sewell Pp 51-129. 2.13 rupees. (Calcutta.)

Union of South Africa Department of Agriculture. Reprint No. 30: Weeds of South Africa, Part 4. By K. A Lansdell. Pp 35. (Pretoria Government Printing and Stationery Office) 3d.

Canada. Department of Mines: Mines Branch. Abrasives. Products of Canada, Technology and Application. Part 2: Corundum and Diamond. By V L. Eardley-Wilmot (No. 675) Pp v+51. 15 cents. Abrasives. Products of Canada, Technology and Application. Part 3: Garnet. By V L. Eardley-Wilmot. (No. 677.) Pp. vii+69. 20 cents. (Ottawa: F. A. Acland)

Union of South Africa: Department of Mines and Industries Geological Survey, Memoir No. 25: A Bibliography of South African Geology for the Years 1921 to 1925 (Inclusive). Authors' Index By Dr. A. L. Hall. Pp. 117. (Pretoria: Government Printing and Stationery Office) 5s

Medical Research Board to 31st December 1926. Pp. 28. (London H. M. Stationery Office) 9 do net

Quarterly Journal of Experimental Physiology. Vol 17: Sutherland Simpson Memorial Volume Pp. vin+210+25 plates. (London: Charles Griffin and Co., Ltd.) 30s.

FOREIGN.

#### FOREIGN.

Methods and Problems of Medical Education. (Seventh Series.) Pp

Methods and Problems of Medical Education. (Seventh Series.) Pp 1v+99. (New York The Rockefeller Foundation.)
Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 24. Studies on Inflammability of Hydrogen. By Yoshio Tanaka and Yazaburo Nagai. in: Influence of Di-ethyl Selenide on the Limits of Inflammability of Hydrogen-Air Mixtures. Pp 205-273. 0 20 yen No 25: Studies on Inflammability of Hydrogen By Yoshio Tanaka and Yûzaburo Nagai. iv 'Influence of Hydrogen Selenide on the Limits of Inflammability of Hydrogen-Air Mixtures Pp. 275-284. 0.20 yen. (Tôkyo Koseikai Publishing Office.)

The Carnegie Foundation for the Advancement of Teaching. Twentyfirst Annual Report of the President and of the Treasurer. Pp. vii+250. (New York.)

No. 3010, Vol. 120]

Proceedings of the United States National Museum Vol 69, Art 5 Catalogue of Human Ciania in the United States National Museum Collections. The Algonkin and related frequoty, Sionan, Caddoan, Salish and Saliaptin, Shoshonean, and Californian Indians. By Alex Hidlicka. (No 2631.) Pp 127. (Washington, D.C. Government Printing Office)

Kominklijk Magnetisch en Meteorologisch Observatorium te Batavia Jaarverslag 1920. Pp 30. (Weltevieden Landsdrukkern)

Proceedings of the United States National Museum Vol. 70, Art 1 A Taxonomic and Ecological Review of the North American Chalcid-Pres of the Genus Callimonie By L. L. Huber (No. 2663.) Pp 114+4 plates. Vol. 71, Art 7 Orthopteroid Insects from the Maritime Province of Siberia (On the Insect Fauna of the Maritime Province of Siberia (On the Insect Fauna of the Maritime Province of Siberia (On the Genus Lepidocyclina related to Lepidocyclina mantelli By T. Wayland Vauchan (No. 2680.) Pp. 5+4 plates. (Washington, D.C. Government Printing Office.)

Smithsonian Institution: United States National Museum Contributions from the United States National Herbarium Vol. 26, Part 2. The Piperaceae of Prinama By William Trelease Pp. v+15-50+vii-viii. (Washington, D.C. Government Printing Office).

Bulletin No. 73. A Rapid and Accurate Means of Estimating Nicotine in Tobacco and Tobacco Estiacts. By Dr. R. R. Le Gevt Worsley. Pp. 5 (Cano. Government Publications Office).

#### CATALOGUES

The Thomas Gas Meter for the Accurate Measurement of Gas Pp. 24 (London Cambridge Instrument Co., Ltd.) (List No. 151)
Siemen J Electrical Distance Thermometers (Pamphlet 840A)
Pp. 12 Siemens Electrical Pyrometers and Thermometers. (Leaflet Pp 12 Stemens Electrical Tyromeons and Co, Ltd)
2050) Pp. 4 (London, Stemens Bros and Co, Ltd)

## Diary of Societies.

#### SATURDAY, JULY 9.

SATURDAY, JULY 9.

British Mycological Soulery (Phytopathological Meeting) (at the Research Station, East Malling, Kent), at 11-30.—R. G. Hatton: General Account of the Station and its Activities.—At 12—Demonstration of Reversion in Black Currants, by Mr. Hatton and Mr. Amos —At 1.30.—Dr. H Wormald Brief Outline of the Pathological Problems under investigation at East Malling—1.45 to 3.45.—Tour of Egham Field and Great East Field, and Examination of Specimens, Cultures, etc., in the Laboratory Features of pathological interest include examples of 'Die-back' in Plum Trees, various Raspberry Anthracnose, and Apple Spraying Experiments against Raspberry Anthracnose, and Apple Spraying Experiments, etc.—At 4.30.—General Discussion

HARVEIAN SOCIETY OF LONDON (at Star and Garter Hospital, Richmond), at 4.30).

## SATURDAY, JULY 16.

Institution of Municipal and County Engineers (Eastern District Meeting) (at Guildhall, Cambridge), at 2

#### CONGRESSES.

#### JULY 11 TO 16.

ROYAL SANITARY INSTITUTE (at Hastings)

Monday, July 11, at 5.—Sir Wilham Joynson-Hicks, Bart.: Inaugural Address.

Address.

Tuesday, July 12, at 10 am—Meetings of Sections, and Conferences as follow:—Sanitary Science and Preventive Medicine, Representatives of Sanitary Authorities, Engineers and Surveyors, Health Visitors

At 8 r.m.—Sir William H Wilcox: Chronic Rheumatism in its Relation to Industry (Lecture).

Wednesday, July 13, at 10 am—Meetings of Sections, and Conferences as follow—Sanitary Science and Preventive Medicine, Personal and Domestic Hygiene, Hygiene in Industry, Authorities of Health Resorts, Sanitary Inspectors

Thursday, July 14, at 10 am.—Meetings of Sections, and Conferences as follow: Engineering and Architecture, Maternity and Child Welfare, including School Hygiene, Veterinary Hygiene, Medical Officers of Health

Health

Heatin Mills of the Am.—Meetings of Sections, and Conferences as follow.—Engineering and Architecture, Materinty and Child Welfare, including School Hygiene, Hygiene of Food, Veterinary Hygiene.

At 8 P.M.—Film illustrating The Treatment and Training of Crippled Children, by Sir Henry Gauvain.

Saturday, July 16—Excursions

#### JULY 18 TO 22.

ROYAL MEDICO-PSYCHOLOGICAL ASSOCIATION (at Royal College of Physi-

ROYAL MEDICO-PSYCHOLOGICAL ASSOCIATION (at Royal College of Physicians and the University, Edinburgh).

July 19.—Dr. H. C. Marr. Dante and Rabelais. An Account of Two Mediæval Physicians, with a Summary of their Philosophy.

July 20.—Dr. W. Hunter, Sir William Willcox, Sir Berkeley Moynihan, Dr. C. H. Bond, Dr. H. A. Cotton, Dr. T. C. Graves, Lieut.-Col. J. R. Lord, Dr. W. F. Menzies, Dr. A. Moyer, and Dr. D. C. Watson: Discussion on Chronic Sepsis as a Cause of Mental Disorder.

July 21.—Dr. Ivy Mackenzie, Dr. J. G. Greenfield, Dr. R. M. Marshall, Dr. G. Riddoch, and others: Discussion on Epidemic Encephalitis.

July 22.—Prof. G. M. Robertson and others: Discussion on Points in the Lunacy Commission (England) Report—(1) What legal facilities are required for treatment? (2) How far is judicial intervention necessary? (3) What safeguards against improper detention are inadequate?



## SATURDAY, JULY 16, 1927.

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No. 3011, Vol. 120]

## New Aspects of the Nitrogen Problem.

CIR WILLIAM CROOKES'S disturbing pronouncement, made in 1898, on the subject of the approaching failure of the world supply of wheat for lack of combined nitrogen, lives in the memory of many. "Are we to go hungry and to know the trial of scarcity?" he asked, and added, "those present who may attend the meeting of the British Association thirty years hence will judge how far my forecasts are justified." Naturally, a negative answer to his question was given at the British Association meeting last year, but had he said "sixty years hence," no one would have dared to give a confident reply. On the other hand, his prophecy in regard to the manufacture of combined nitrogen has come true. Led by Germany, nearly every civilised country in the world is actively producing synthetic fertilisers. Now, it should be noted that Crookes confined his attention to the need for nitrogen in the production of wheat. Recent events in the agricultural world, however, justify some consideration being given to a wider aspect of the nitrogen problem; for, as a recent writer has said, the sum total of life upon this planet is limited by the amount of available nitrogen in combination; important as wheat is in human dietetics, the supply of meat is equally vital. The farmer everywhere is in fact engaged in the manufacture and marketing of combined nitrogen in one form or another. He buys nitrogen in the form of manures and feeding stuffs, and markets it again as corn, meat, or milk. He makes nitrogen when he sows clover and other leguminous plants; and he conserves it for future use when he lays his land down in grass.

Under ordinary farming conditions in Great Britain, meat and milk are not produced by grass alone. Intensive farming requires that animals shall be fed on concentrates, that is to say, foods rich in nitrogen, and the use of such foods has two advantages: the protein they contain goes in part to make meat or milk, while the portion not digested, as well as that eventually rejected as waste, goes to enrich the soil. It follows that intensive agriculture in the last analysis involves a process whereby foreign nitrogen is brought on to the farm, is converted into products such as corn and meat, again, in part leaves the farm, and in part is added to the soil. We have, therefore, two stages in the exploitation of land for the production of human food, one typical of the apical development of medieval farming, in which the soil of a locality produces the maximum of human food by the united efforts of Nature and the farmer, and the other, typical of farming after the discovery of artificial manures and feeding 'cakes,' in which nitrogen in one or other of two forms is brought on to the farm from outside, subjected, in part, to a conversion process and added to the sum total of home production of food. It may be noted, too, that the purchase of foreign feeding stuffs is merely a transference of nitrogen ' made ' by natural agencies from one portion of the globe to another. In the case of ordinary nitrogenous manures, also, Nature plays a leading part; ammonia salts are waste products of coal consumption: sodium nitrate from Chile is believed to come fundamentally from the excreta of sea-birds, and others, such as blood, bones, etc., are in the same category.

Since the days of Crookes's vaticinations, however, we have entered on a third stage. Agriculture is now drawing on a purely artificial and non-natural source of combined nitrogen, one that makes no call on the resources of the soil elsewhere, or on the natural agencies by which atmospheric nitrogen enters into combination. "The fixation of nitrogen," said Crookes, "is one of great discoveries awaiting the ingenuity of chemists. . . . It is vital to the progress of civilised humanity. . . . Unless we can class it among certainties to come the great Caucasian race will cease to be foremost in the world, and will be squeezed out of existence." The hoped-for discovery has now been made. As a recent writer has said, "It is now the era of nitrogen plenty." The estimated world production of combined nitrogen is now about one and a quarter millions of tons, and it is increasing rapidly year by year. But how does the production of combined nitrogen affect human food? Crookes answered the question so far as wheat is concerned. What about meat and milk? It is obvious that if meat is produced by the feeding of a cereal (such as oats) to animals, an abundance of synthetic nitrogenous fertilisers should cheapen the production of meat. But, as matters stand, the cost of meat is governed by the price of the pasturefed animal plus the cost of purchased foreign foods. In favoured regions in Great Britain it is possible, no doubt, to fatten an ox on home products alone, but in any event the store animal, that is, the animal before it is 'finished' for the butcher with albuminoid and fatty foods, is a product of grass lands. It follows, then, that if we could invariably feed a cow, or finish an ox or sheep on grass alone, we should relieve the farmer of a big item of costthat of cake and corn purchased outside the farm.

We have, then, narrowed the problem to this.

Is it possible by the use of synthetic nitrogenous fertilisers so to improve our pastures that they will be capable of fattening the meat-producing animal? Science has something to say on the subject—and something new. Research on animal nutrition, led by Kellner, the well-known German worker, has been proceeding for more than a generation. Grass in the form of hay has not been overlooked. Its energy value, its starch-equivalent, have been determined: its practical feeding value for maintenance, for production, either alone or in combination with other foods, has been ascertained, but until quite recently its precise value in pasture conditions was unknown.

Scientific knowledge has, however, recently made a great advance. Workers in the Cambridge School of Agriculture have proved that young pasture grass, that is, grass before any lignification of the tissues has set in, is entitled to rank as a concentrated food, both in respect of protein content, digestibility, and starch-equivalent. Its dry matter actually contains so much as 25 per cent. of digestible protein and 75 per cent. of starchequivalent. Further, being the natural food of herbivores, we may assume that its mineral and vitamin contents are properly balanced. So that now a scientific view of the subject warrants the confident statement that if the farmer can supply his milch cows and fattening animals with an abundance of young grass, he can reduce the purchase of extraneous foods. Further, as a means of producing that abundance, he can use synthetic nitrogenous fertilisers; and this is not simply a paper philosophy. During the past two years the theory has been tested in Great Britain on a number of farms (including that at Melchet Court, the property of Sir Alfred Mond), and it has been demonstrated that, provided pasture land is kept closely grazed and that growth is continuously stimulated with nitrogenous and other manures, animals can be kept in healthy productive condition for six months in the year on grass alone. Moreover, and this is important, the number of animals which can be so kept on a specified acreage is greater than that possible by ordinary farming methods.

Of course, productive animals cannot be kept on grass all the year round; at the most they can be so kept for six months in the year, and in any case the practical farming problem presented by the new scheme is far from simple. Under any conditions grass does not grow at a uniform rate during these six months, and consequently a problem of management has to be faced which, for its solution, may necessitate both feeding for limited periods with foreign foods, and the setting

apart of an area of grass land for hay in the standard way. Two further scientific problems also await solution—one, for the plant-breeders, is the making of plants capable of producing a growth of herbage during part of the winter months; the other, for the engineer, is the feasibility of cutting grass in the young condition and preserving it during the winter. A solution on the former lines does not appear to be likely, but the possibility of the second solution is well in sight. The leading producers of synthetic ammonia in Great Britain are actively engaged in exploring the whole problem. (See, for example, "Farm Notes," issued by Messrs. Nitram, Ltd.) They have in operation an extensive series of field trials of which the object is to test the new system of rotational grazing of grass treated with combined nitrogen they are also at the present time making a cake of dried and compressed young grass, and feeding experiments with this substance will be initiated in the coming autumn and winter.

An approach is therefore being made to the complete realisation of Crookes's dream, namely, that the requirements of the country for combined nitrogen shall be satisfied within the country itself—that our imports of that vital requirement shall be reduced to a minimum. Be that as it may, it is satisfactory to know that, as a result of the enterprise of the latest of the great industrial corporations, a further exploitation of the nitrogen problem, as envisaged by a great man of science, is being undertaken.

## Variety and Environment in Lizards.

Der Artenwandel auf Inseln und seine Ursachen, ermittelt durch Vergleich und Versuch an den Eidechsen der dalmatinischen Eilande. Von Paul Kammerer. Nebst einem Anhang: Zur Systematik der adriatischen Insel-Eidechsen, von Otto Wettstein. Pp. xiv + 324 + 8 Tafeln. (Leipzig und Wien: Franz Deuticke, 1926.) 30 gold marks.

MELANCHOLY interest attaches to this paper, the last from Kammerer's pen, which was published only a few months before his tragic death last year. Like his other publications, it is based entirely on work done before the War; for since the War, owing especially to the socialism which became rampant in Vienna, the University of Vienna has become so impoverished that it was unable to pay any but starvation salaries to its staff, and Kammerer left its service and supported himself by journalism and popular lecturing from 1924 until his death.

In 1909 and 1911, and again in 1914, Kammerer No. 3011, Vol. 120]

made a prolonged tour amongst the Adriatic islands, visiting in all fifty of them. The size of the islands varied from tracts of country equal in area to the Isle of Wight to mere islets a few hundred yards across and rocky 'skerries' The object of these excursions was to find out whether distinct races of continental species of animals were to be found on these islands; and if so, how they were related to their nearest allies on the adjacent continent. As he himself says, his purpose was to follow in the footsteps of Darwin and Wallace, and to glean from the study of these island races light on the origin of species.

A preliminary investigation convinced him that the most suitable animals for his purpose were lizards, for these abound in all the islands. Seven species in all were found, namely, two geckos, Tarentola mauretanica and Hemidactylus turcicus, one 'blind-worm,' Ophisaurus apus, and four species of Lacerta, namely, L. major, L. oxycephala, L. serpa, L. flumana. Of these seven species, however, Lacerta major (which is a large form, 18 inches to 2 feet long) and the 'blind-worm' Ophisaurus showed no variations; Tarentola has the habit of clinging to ships and driftwood, and so owes its wide distribution to human agency. Kammerer's attention was therefore concentrated on the remaining four. The gecko Hemidactylus is a nocturnal or at any rate a crepuscular species. and Lacerta oxycephala confines itself almost exclusively to bare rocks. The other two, L. fiumana and L. serpa, are, however, diurnal and frequent herbage and brushwood, and it is they which show marked variations in the different islands, and it is from the study of them that Kammerer obtained the most light on the problem which he sought to solve. These two species, according to Kammerer, are 'good' species. he says that the experienced naturalist never mistakes the one for the other in the field, but that when their diagnostic characters are masked by superimposed 'island' characters they are difficult to distinguish. L. serpa inhabits the whole of the Italian peninsula and L. fiumana the whole of the Balkan peninsula, but the line of division between their territories runs along the Balkan coast, so that several large islands there fall to the share of L. serpa; and, curious to relate, it sometimes happens that an island is occupied by one species and the rocks around it by the other. Kammerer has some speculations as to the geological causes of this irregularity of distribution, but they are outside the scope of the subjects with which this review has to deal.

It should be noted in passing that Boulenger regards these two species as local varieties of Lacerta muralis, and with this opinion the reviewer, after inspecting the types at the British Museum, is inclined to agree; but whether they are considered as true species or varieties is entirely irrelevant to the question at issue. Their territories never overlap: even in the rare cases where they are both found in one of the larger islands, the areas which they respectively inhabit are separated by a 'lizardless' band of country.

Both L. serpa and L. fiumana give rise to wellmarked island varieties, and the most marked of these are found in the smallest islands. In the larger islands it is only possible to find distinctions between island and continental populations by the statistical method: isolated individuals often turn up with peculiarities which become constant and universal in the populations of the smaller These smaller islands, therefore, constitute the crux of the problem, and in endeavouring to account for the production of the strongly marked varieties found in them, Kammerer is approaching the problem of the origin of species from the same viewpoint as did Eimer long before him; for Eimer began his investigations into the causes of evolution by finding and describing a distinct 'variety' or species of lizard on one of the Faraglioni—the rocks in the neighbourhood of the island of Capri in the Bay of Naples.

These varieties differ from the type in colour, size, and shape. The colour of the type is green or greyish-green, with longitudinal rows of dark patches on the back and blue 'ocelli' in various places, such as the armpits and the underside of the throat. The colour below is yellow, sometimes with a reddish tinge, or pale grey. The island varieties can be jet-black, so that markings are not distinguishable from the background; they may be half as long again as the type and broad in proportion, and the tail is marked by a peculiar thickening just beyond its origin.

That isolation is an all-important factor in the production of varieties is clear from the fact that when two populations on the same islet are separated by some barrier which prevents them from intermixing, incipient differences make their appearance. Thus in the islet of Tajan there is a deep valley with perpendicular sides which completely separates the lizards of the eastern half of the island from those of the western half, since no L. serpa will ever climb downwards. The eastern lizards show in the male sex a red coloration on the belly, whilst in the western half both sexes show it.

Granted that isolation is a pre-requisite for the formation of a new variety, it can only act by preventing cross-breeding, and the question remains to be answered—is it chance variation accompanied by natural selection, or is it the direct action of the environment that is the effective cause of the change? Kammerer first examines the case for natural selection. If the black colour is protective, against which foes does it protect? The main enemies of the young lizards are the older lizards. rats, crows, and snakes. But the young in most cases, as on the islets Pomo and Melisello, show considerable traces of the ancestral colouring and only attain full blackness as they grow up, when the first of the enemies is no longer effective. Rats are nocturnal and hunt by scent, and are only found in some islands. Crows only visit islands near the coast, and snakes only occur on a few of the islands. Seagulls never attack lizards, which have, as a matter of fact, established a kind of symbiosis with them, for the lizards haunt the nests of these birds and search the plumage of the nestlings for parasites without molestation; at the end of the nesting season the lizards are plumper and in better condition than at any other time.

On the other hand, Kammerer was able to bring proof that the melanism is due to the direct action of the environment and principally to one factor in it, namely, radiation from rock surfaces. Here he anticipates and answers an objection raised by many naturalists (amongst them Prof. Graham Kerr in his recent book on "Evolution") that only work in the field can detect the causes of evolution, since experimental work, under laboratory conditions, can give no idea of what goes on in Nature. Kammerer replies that field observations can give suggestions as to the causes of evolution. but that the validity of these suggestions must be controlled by experiment. Now Kammerer shows that healthy young Lacerta serpa of typical green colour can be rendered quite dark if exposed for  $1\frac{1}{2}$  to 2 years to strong radiation reflected from stones. If such a pair in middle life are transferred to normal conditions and allowed to breed, they will produce normal green young, but these when they grow up under typical conditions nevertheless repeat a certain portion of the parental darkening. From every island which Kammerer visited, never fewer than twenty and sometimes as many as fifty specimens were sent home to Vienna and there made the subjects of experiments.

The experiment just referred to is only one of a number of which Kammerer gives an account, and they leave no doubt in the mind of the unbiassed reader that Kammerer has fully proved his point. As to the causes of the increased size and the thickened tail, Kammerer freely confesses that he has only surmises; since in the few generations he was able to rear, before the War interrupted his labours, he was unable to analyse their causes by experiment. He thinks that both are cases of over-compensation following respectively on starvation and injury. The black lizards go through seasonal orgies of abundant food, alternating with periods of starvation, and the loss of the tail, owing to mutual quarrels on the islands, is so frequent that the lizards are known to the natives, not as black—that is taken for granted—but as the lizards 'of many tails'

Not only did Kammerer blacken green lizards by exposing them to dryness and radiant heat, but he recalled the black lizards of Melisello to their ancestral green colour by keeping them for two generations in a cool and moist atmosphere He analyses the anatomical bases of the colour There are three pigments—a vellowish-red lipochrome, melanin, and lastly guanin, which produces the blue colour by interference effects. The green is due to the combined effect of the guanin and lipochrome. He shows that as the temperature of the vivarium is increased, first the lipochrome and then the guanin is destroyed, and the melanin extends its range. This state of affairs is reached at 37° C. As the temperature is increased to 39° C., which is the utmost that the lizards can stand, the melanin disappears and a bleached albino results.

The response to radiant heat varies from species to species. L. serpa responds more quickly than L. fiumana. The more a variety is accustomed to heat in its natural habitat, the more slowly it responds to increased heat. The southern populations of L. fiumana are extremely resistant—it looks as if they had acquired an 'immunity' recalling the immunity produced by vaccination

Kammerer of course does not deny the existence of natural selection, but he insists that what is selected is not the random variation in a lucky direction, but the individual that responds best to the environment. Variation, he says, appears at first sight to be random, but when it is looked into closely it is quite orderly and consists of plus and minus variants on a typical mean. There are different systems of organs which he mistakenly compares to the Mendelian genes, which react independently of one another. Thus in some varieties of lizard, blackening is attained by the appearance of melanin in the background; in

others the black patches of the pattern spread until they overwhelm the background. Further, lizards and snakes, like amphibia, have the power of adapting their colour pattern to that of the environment, and this power is exercised through the eye. It is a question of a delicate balance of stimuli whether this power, or the direct response of the skin, shall gain the upper hand. In the islet of Pelagosa, for example, which is covered by a yellowish-green vegetation, L serpa is bright green but the snake Zamenis is represented by an intense melanic variety. The gecko Hemidactylus has a particularly mobile response to its environment by change of colour, recalling in this the well-known chamæleon, yet even here the environment makes an impress on the hereditary constitution, for there is one islet where, owing to the absence of Lacerta, this species has become diurnal, and Kammerer ascertained by keeping this variety alongside of typical specimens in the same vivarium in Vienna that the responses of variety and type to the same environment were different. Kammerer maintains, in fact, that the first step in the formation of a variety is a continual heightened response in the same direction which gradually become engrained in the constitution. "Physiological change precedes morphological change." L. oxycephala, as mentioned above, frequents bare rocks and, unlike L. serpa and L. fiumana, will descend as well as ascend This species has given rise to a black variety on the upper and slopes of the mountains of Herzegovina (L. oxycephala Tomasinii), where the lizards are exposed to pitiless radiation. Thus a variety can originate just as well on the mainland as on an island if intercrossing with neighbouring groups is prevented.

We may in conclusion say a word on the addendum by Dr. Wettstein. This is an admirable systematic review of the Kammerer material. He establishes several new sub-species on the basis of this material, and he mentions the fact which has a direct bearing on the causes which broke Kammerer's heart and drove him to suicide, namely, that a good deal of this material had lost all its colour and was hopelessly macerated and ruined when he came to examine it, by neglect in the museum during and after the War. The reviewer is aware that he speaks for only a small minority of his colleagues, but he predicts that in twenty or thirty years' time, when those fierce partisans whose calumnies were out Kammerer's courage and drove him to his death, have passed away, Kammerer will be ranked alongside Lamarck, Darwin, and Wallace as one of the great architects of evolution.

Really, when one passes from perusing the endless and fruitless pursuits of the elusive gene by the Mendelians, to reading the clear and beautiful arguments of this work, one has the feeling of having passed from the babbling of the nursery to the reasoned debate of the forum

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E. W MACBRIDE

# The Founders of Seismology.

The Founders of Seismology. By Dr Charles Davison. Pp.  $x_{1i} + 240$  (Cambridge . At the University Press, 1927) 12s. 6d. net

THE title of this book at once raises the question of what is a founder For Dr. Davison the answer is simple, he is any one who is no longer living. Yet a different point of view might be adopted, for, if an architectural metaphor is to be used, the history of few branches of knowledge can be divided more readily than seismology into the two periods, of laying the foundations and of building the superstructure. The limit between the two periods lies in the first decade of the present century, and may be more precisely fixed at the time of the Californian earthquake of 1906. Subjected to elaborate investigation and a sumptuous publication of results, the increase of knowledge and the precise measurement of effects, which had only been recognised in a qualitative and even uncertain way, was very largely instrumental in inspiring a change in our outlook on the fundamental principles of both the old and the new seismology.

Earthquakes have been a subject of study from early times, but the science of seismology, in its more modern sense, did not begin before the eighteenth century, and by the middle of the nineteenth the main principles had been established on which all further work has been based So far, however, the science had only dealt with the seismos which was known to and studied by the ancient Greeks-that is, the disturbance which can be felt, which may cause damage or destruction to the works of man, or may alter the features of a landscape, according to the degree of violence attained, but in the last decade of the century a new seismology was born. The incarnation of this new science may be dated from the discovery, by Rebeur-Paschwitz, that records could be obtained, with suitable instruments, of disturbances, evidently connected with destructive earthquakes, at places far beyond the region in which even the feeblest manifestation of the work could be detected by the unaided senses of man; and by the

beginning of the following century it had been well established, and generally accepted, that these distant records revealed the existence of three distinct forms of wave motion, travelling at different rates and along different paths, from the origin to the place of record. This is the foundation on which has been reared the whole superstructure of that newer seismology which has shown us that the earth is composed of a series of concentric shells of materials, differing in physical character and, presumably, in chemical composition; which has given rise to investigation of the character, and revealed the existence of previously unsuspected forms, of wave, and to other results which only a generation that has forgotten, or chosen to ignore, its Greek could describe as seismology, but are equally interesting and important by whatever name they may be called.

Nor has the older seismology stood still report on the Californian earthquake of 1906 still belongs to the period of foundation-laying. The work was dominated by the idea of a centre of origin, though this was no longer regarded as of such limited dimensions that it could be treated as a point; it had become a fissure extending for a length of nearly 300 miles, but was still regarded as the origin both of the destructive earthquake and of the distant records. The cause, too, was regarded as the shock resulting from fracture, due to a slowly growing strain, which had gone on accumulating, with occasional partial relief, for a period of at least a century. A re-examination of the record of older earthquakes, and the study of more recent ones, has altered this; it has been found that, in destructive earthquakes, the origin of the surface shock is not so simple as had formerly been supposed, that instead of being a single fracture, or limited to the central portion of the affected area, the origins are often very complicated and spread over a large proportion, even to almost the whole, of the tract over which the shocks can be felt; it has also been found that the origins of the surface shock and of the unfelt distant record are by no means the same. The destructive earthquake can be proved, by local observations, to be of very shallow origin, generally, if not always, of less than ten kilometres in depth, and the same is true of the great majority of shocks which can be felt but do not cause damage or give rise to distant records. The disturbance which is registered at long distances has been shown, by the great series of observations studied, especially by Prof. H. H. Turner, to originate at depths which must be

measured in hundreds of kilometres, and the examples are steadily increasing in number where the geographical position of the origin of the longdistance records does not agree with that of the greatest violence of surface shocks, but may be at a considerable distance, even to a hundred miles or more Yet the two are evidently in some way connected with each other, and if we liken the origin of one to the discharge of a great gun and of the other to the explosion of its shell, it is easy to see that the disturbance produced by its own charge of explosive would be very different from that which would result if it happened to strike an ammunition waggon or dump. In this way we may dimly realise the connexion between the long-distance record and the earthquake proper, and may find an explanation of the fact that there seems to be no quantitative relation between the two, a highly destructive earthquake may give a small record, while a much larger one may accompany a disturbance which is only felt as a moderate and harmless shock near the origin.

Such, in brief outline, is the scheme on which a useful and interesting book might be written. Dr. Davison, in dealing with the works only of those individuals who are no longer living, has adopted a safer and probably more permanently serviceable line This course is not devoid of inconvenience, for the end of some has been so recent, in two cases so late as 1923, that their work belongs as much to the building of the superstructure as to the laying of the foundations, and the absence of reference to the work of those still with us leads to a very partial and even misleading aspect of the present state of our knowledge. This, however, forms but a fraction of the work, the rest of it gives us something that was much wanted A general knowledge of the early history of the subject of his study is useful to every worker, but for each to go separately through the old literature would be an unjustifiable reduplication of toil, which Dr. Davison's work has rendered unnecessary. An extensive and, what is more important, an accurate reader, Dr. Davison has in pre-eminent degree the knack of extracting the nutricious kernel from the husk and shell in which it is clothed, and of expressing clearly those results which are of permanent interest or importance. He has produced an excellent account of the early history of the study of seismology, which contains what every serious worker at the subject ought, and all that, except for very special research, he needs, to know, of these older works and workers. R. D. O.

## Newton and Descartes.

- (1) Sir Isaac Newton a Brief Account of his Life and Work. By Prof S Brodetsky. Pp xii+161 (London Methuen and Co, Ltd, 1927) 5s net
- (2) La vie raisonnable de Descartes Par Louis Dimier (Le roman des grandes existences, Tome 5 ) Pp vi+281 (Paris Librairie Plon, 1926.) 15 francs
- (1) PROF BRODETSKY has followed up his great success in organising the Newton celebration at Grantham by publishing what is easily the best short book on Newton's life and work. It is really even more than this, for it would be difficult to find anywhere a clearer and more instructive account of the genesis and meaning of the differential and integral calculus, as well as the way in which the law of gravitation brings together and completes the work of Galileo and Kepler. All this is done by a first-rate mathematician with a turn, like his hero, for the practical and applied side of mathematics.

To have accomplished this, with a lively narrative of Newton's personal life and all the relevant public occurrences of the time, within a compass of 160 pages, is a remarkable feat, and it is to be hoped that Prof Brodetsky will go on to employ the talents which he has revealed in this volume by treating some other of the great figures in science in the same way Nothing could be more stimulating to a young student than to read and re-read this book, mastering the admirably simple diagrams and looking up the references to contemporary thinkers with whom Newton was in touch. It is, in fact, a model of how the history of science should be presented—short, interesting, personal, suggestive, and competent. It does not attempt to cover the ground of the sciences which Newton studied and advanced, but it illuminates the advance and creates at every point that most wholesome of all appetites—the desire to know more.

To the student of general history, the connexions with other contemporary events, with which Prof. Brodetsky rightly and richly sprinkles his pages, will be specially welcome, for they help to build up the growing idea of the unity of history, and they show also how easily and in what small space it may be done, if we set out to do it and have the requisite knowledge. Newton's general philosophy fits in with that of Milton, whose "Paradise Lost" was completed at the same moment as Newton's two capital discoveries, Newton practised jumping with and against the gale in the storm which accompanied Cromwell's

death; the first part of the "Principia" was published just as Charles II. was dying, and with the *imprimatur* of Samuel Pepys; and so on

Une œuvre de vulgarisation du premier ordre

(2) Close on Prof. Brodetsky's popular account of Newton comes a short French book on Descartes which offers other points of interest. M Dimier, as compared with Prof. Brodetsky, is literary, personal, and, above all, Catholic His book is beautifully written in a terse, pointed, and unadorned style, and Descartes is a still more unqualified hero to him than Newton is to the English writer.

Two capital and connected points are aimed at in the treatment. first, that Descartes' thinking was essentially synthetic and religious; second, that he was primarily inspired in his philosophic work by a desire to combat the popular scepticism of the day.

If one makes due allowance for the one-sidedness and exaggeration of this view, one may certainly gain a good deal of sidelight both on Descartes' work and on the life and thought of his time.

It is true—on the first point—that Descartes was primarily metaphysical and philosophic, whereas Newton was primarily mathematical and positive. Newton was above all concerned to make sure of his conclusions with regard to a particular law or set of observed facts. Descartes was from the first seeking to know, and to connect the whole of his knowledge in one coherent and unassailable This is in general the difference between the philosophic and the scientific approach, and it may be paralleled in the nineteenth century by the difference in the attitude and the influence of two leading men-again a great Frenchman and a great Englishman - Comte and Darwin. each case the influence of the philosophic type is more diffused and indirect, and of the scientific more direct and constructive of fresh scientific truth.

On the Catholic question which pervades the book before us, it is sufficient to say that while Descartes was never anti-Catholic or sceptical, and conceived his main work to be the establishment of a body of certainties on a deistic basis, yet he certainly did not start from theology but from mathematics. His philosophy was inspired by mathematics, and he feared assaults from Catholic critics as much as from the Calvinists who got up a great case against him in Holland. On the details of all this and of his correspondence on moral questions, M. Dimier is instructive and interesting, and well deserves to be read.

F. S. Maryun.

The Chemistry of Petroleum.

The Scientific Principles of Petroleum Technology
By Prof. Dr. Leo Gurwitsch Translated and
revised by Harold Moore Pp xvi+470+8
plates (London Chapman and Hall, Ltd,
1926.) 25s net

FURTHER addition to petroleum literature A is at the present time almost a challenge to criticism, in view of the voluminous writings extant on every possible branch of the subject, only flagrant heresy and iconoclasm, a brand-new theory of origin, for example, would seem to justify a new text Though this book claims neither excuse, it is acceptable for three good reasons. that it has been an authoritative German text since 1912, revised in 1924, and now admirably renovated for the benefit of English readers by its translator, Mr Harold Moore, that it presents the European and not the American viewpoint, and that it is less concerned with commercial oil-refining than with the scientific principles on which that industry The author holds high academic office at the University of Baku and, as might be anticipated, his writing is coloured with experiences of Russian petroleum and biassed to the work of European colleagues, truly a refreshing departure from recent tendencies.

We have here a real text-book of the chemistry and physics of petroleum, two remarkably complex subjects when considered for their own sakes and not for their economic applications; in fact, one of the features of this volume is its indication of the enormity of unfinished research, of work still to be done, of knowledge yet to be gained, before we can claim understanding As a text-book it leaves little to be desired Carefully arranged, lucid in style, concise in presentation, entirely technical but never fogged with petty detail, masses of formulæ or wild speculation, the work makes an immediate appeal and deserves, as it will undoubtedly achieve, a place in the front rank of English literature on the chemical technology of petroleum.

The discussion centres on three main factors: raw material, manufacture, and products, each treated from the scientific viewpoint, i.e the first principles involved. Petroleum, the raw material, is first reviewed and its chemistry and physics explained so far as this is at present possible. Manufacture concerns essentially distillation processes and sulphuric acid refining. The products benzine, illuminating and lubricating oils, paraffin wax, and vaseline are similarly described. While

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theory and experiment remain uppermost throughout, the rationale of industrial operation is not neglected, but rather follows as an illustration of the doctrines expounded.

Deficiencies there are bound to be in a work of this character, but they are for the most part innocuous: the treatment of sulphur and nitrogen compounds is poor in its brevity (pp. 113-119), likewise mert gas components of natural gas (p. 124); the misuse of the geological term weathering as applied to evaporation of petroleum (p. 175); the data of crude oils of the world are antiquated and there are serious omissions of Mid-Continental and Colombian crudes (Ohio-Indiana is not the accepted Mid-Continent field); the use of the term 'resm' (p 200) for the asphalt-content of Balachany oil is misleading and should not be allowed to confuse an already clumsy and 'muddy' nomenclature, the section on products is far more sketchy than the rest of the text, especially in regard to the vital subject of lubrication. All this pales, however, by the excellence of the translation and the esteem which one instinctively feels for one who is a master of a particularly complex subject Prof. Gurwitsch is fully entitled to renewed congratulations.

# Our Bookshelf.

The Epic of Mount Everest. By Sir Francis Younghusband Pp 319 + 16 plates (London: Edward Arnold and Co., 1926.) 7s. 6d. net

SIR Francis Younghusband has written a concise and inspiring account of the three expeditions which were organised by the Royal Geographical Society and the Alpine Club. The first expedition reconnoitred the mountain in 1921, the following year the second expedition attempted to climb the mountain, but failed to reach the summit. At the climax of the third attempt, in 1924, Mallory and Irvine were seen for a moment climbing fast, and within reach of the goal. Did disaster overtake them before or after they accomplished their task? Unless those two gallant climbers did in fact reach the summit, and left a record there, the mystery may never be solved.

The author makes it clear that the ascent of Mount Everest is possible, and the mountain will eventually be climbed. He attributes the failure in 1924—if indeed it was a failure—to two causes. The first was the exhaustion of the best climbers in the gallant rescue of four porters, who had lost their nerve in coming down from Camp IV. The second was the attempt to use oxygen. Oxygen does not increase the strength of a climber sufficiently to make up for the weight of the apparatus.

Though the ascent of Everest is possible, it can never be easy or safe. Only the toughest and

most determined climbers have any chance of reaching the summit, and to do so they must first acclimatise themselves to altitudes of more than 20,000 feet. In order that the climbers may reach the last stage in good condition, at least six camps must be established between the base at 17,000 feet, and the jumping-off point at above 27,000 feet. This involves the use of a large number of porters; the 1924 expedition employed seventy, but had not enough. Finally, the weather must be propitious.

There can be no doubt that, if the Tibetan authorities once more open the road to the mountain, Everest will be attacked again and again, until it is vanquished. The victory will not add anything to human knowledge, or to the material wealth of the world. But the mountain offers a perpetual challenge to the boldest climbers. To use Sir Francis Younghusband's own words, "Everest stands for an adventure of the spirit." Yet amongst those who, from the scorching plains of India or the arid plateau of Tibet, lift up their eyes unto the hills, there may be some who mutely hope that the uttermost peak may never be desecrated by the foot of man; and that also is an affair of the spirit

Essentials of Volumetric Analysis. an Introduction to the Subject, adapted to the Needs of Students of Pharmaceutical Chemistry. By Prof. Henry W. Schimpf. Fourth edition, revised and enlarged by Dr Alfred I. Cone. Pp. xiv + 370 (New York: John Wiley and Sons, Inc., London: Chapman and Hall, Ltd, 1926.) 15s. net

As an introduction to the subject, this book doubtless covers the requirements of students of pharmaceutical chemistry. It does not, however, in matters of detail, arouse the reviewer's enthusiasm. The introduction of unusual abbreviations is confusing; the arithmetical examples are frequently expounded in an unnecessarily elementary manner; the use of exactly normal solutions, instead of the employment of a factor, is directed; the explanation of the use of excess of free acid in permanganate titrations is incomplete, so as to be quite mis-leading; the use of the symbol O<sub>3</sub>, except to in-dicate a molecule of ozone, is to be deprecated; the standardisation of N-sulphuric acid by titrating 10 c.c. with "recently prepared and standardised N-potassium or sodium hydroxide" is open to obvious criticism. In addition to the usual inorganic volumetric exercises, the analysis of sugars, oils, alkaloids, urea, formaldehyde, and organic nitrites is described, and a short section is devoted to the principles underlying the determination of hydrogen ion concentration.

A Treatise on Viticulture. By Prof. A. I. Perold Pp xi + 696. (London: Macmillan and Co., Ltd., 1927.) 25s. net.

ALTHOUGH written at Stellenbosch, South Africa, and dealing very largely with viticulture in South Africa, this work is also applicable to cultivators and students in other parts of the world, for the

author gives many particulars of outdoor vine culture in California, Australia, and Europe, and describes very fully the several species of Vitis from which the cultivated grapes have originated The book is not meant for the cultivator alone, but also for students, for it embraces all phases of the vine, passing from the historical, morphological, and biological, through the various processes of cultivation, to the preparation and marketing of the crop in the numerous forms in which it appears in commerce

Following a general introduction, the author discusses both the external and internal morphology of the vine, the descriptive matter being aided by good illustrations. More than forty pages are then devoted to biological questions, which include germination of seeds, the factors governing bleeding after pruning—a question that often gives considerable trouble in Great Britain if pruning be left rather late—development of shoots, fructification, the chemical composition of grapes, ripening of

wood, etc.

Chap. iv. deals with classification. Reference is made to the various genera composing the family Ampelidaceæ, then the numerous species of Vitis are reviewed, with special descriptions of those which produce grapes of commercial value, or are suitable for stocks on which to graft or bud cultivated forms or hybrids The numerous hybrids between American species are described and comparisons are made between them, and between them and the European and Asiatic forms of Vitis vinifera.

A special chapter then directs attention to details of propagation, and another to diseases and their treatment. Chap. x. deals with cultivation, giving special attention to manuring; whilst the following chapter describes methods of pruning and training. The remainder of the book is devoted to the products of Vitis and their prepara-

tion for the market.

The book is likely to prove of considerable value to students, cultivators, and others interested in the vines and their cultivation.

The Zeiss Works and the Carl Zeiss Foundation in Jena: their Scientific, Technical, and Sociological Development and Importance popularly Described. By Prof. Felix Auerbach. Translated from the fifth German edition by R. Kanthack. Pp. iv + 273. (London: W. and G. Foyle, Ltd., n.d.) 10s. 6d. net.

THE name of Abbe will probably remind most English readers of a certain theory of image formation in the microscope, perhaps also of some refractometers and other optical devices, but now that Prof. Auerbach has turned minstrel, and produced the saga of the Carl Zeiss Foundation with Abbe as the hero, protean, magnificent, we can scarcely escape the conviction that his hero's claim to greatness lies as much in sociology as in optics.

The fact that the first half of this well-illustrated book is a kind of conversational illustrated catalogue of the Carl Zeiss products and their history, an excellent advertisement through its atmosphere of

solid achievement and great potentiality, is not without significance in explaining the production of the English translation This part of the book calls for no particular comment, except that certain outside inventors whose instruments have been made by Zeiss might have been mentioned, to say The latter part of the book, however, the least will well repay any student of industrial organisation who finds time for its perusal As Prof Cheshire observes in his foreword, Abbe's scheme has now passed through the experimental stage It has survived the shocks of war and war's ending Its story is told with genuine feeling, not untouched by poetry, as befits a modern saga

The epilogue laments that "the German people are impoverished, their savings, large and small, are gone and their purchasing powers have dwindled to the lowest level "Several pages in the book are devoted to a description of the Zeiss planetarium, and we now hear that at least eleven German cities Those who know have ordered such instruments the cost of these will have much more respect for the purchasing power of the German people than

seems to be the lot of Prof. Auerbach.

An Asian Arcady: the Land and Peoples of Northern Siam By Reginald le May. Pp. xiv+274+64 plates. (Cambridge: W Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd , 1926.) 21s. net

Northern Stam—the Lao country—has received little attention from travellers, and although the teak trade has attracted not a few Europeans, information about it is scanty. This is the more to be regretted as it well deserves Mr. le May's designation of 'Arcady,' and its people ethnologically present many points of interest. This account of the country and its people is therefore welcome, especially as it is illustrated by a large number of excellent photographs. The author has dealt with his subject historically and analytically in an ethnographic account of Lao customs and beliefs, which, though not systematic, contains many interesting data; and descriptively, in an account of a journey through the country. He has also included extracts from the references of early travellers. The first of these is Marco Polo, who, however, did not visit the Lao himself Lao were originally an offshoot of the Tai from China, and ethnologically they stand midway between the Shan and the Siamese. Nominally Buddhist, their beliefs are largely animistic, with a firm belief in the power of witches. A characteristic practice is that of roasting the mother of a new-born child, a custom also followed in the Malay peninsula—in a recently reported case with fatal results.

Racial Origins of English Character: with an Appendix on Language. By R. N. Bradley. Pp. 192. (London: George Allen and Unwin, Ltd., 1926.) 6s. net.

WHETHER mental qualities can be associated with racial characters is a question to which both anthropologists and psychologists have recently devoted

considerable attention, but with no marked result Yet it is a matter of some moment, especially in the application of the results of science to the practical affairs of life. Mr. Bradley, boldly ignoring difficulties, has presented his readers with an analysis of the English character and achievement in the various departments of life-religion, politics, literature, science, and art—which is based upon the racial differentiation into Nordic, Aloine, and Mediterranean. He has an acute observation, a wide knowledge of his fellowcountryman, and a pretty sense of humour courage in essaying a difficult task will no doubt receive its due reward in a shower of hostile criticisms; but we hope that his critics will at least be grateful that he has given them something to criticise and that his mistakes may lead to the elaboration of a sounder method Mr. Bradley, in evaluating racial character, relies upon material which ultimately is based upon impression the psychologist can devise some objective method of determining and evaluating racial mental characters, study of the question is rendered nugatory by the personal equation.

Leitfaden der praktischen Experimentalphysik fur Vorlesung und Unterricht. Von Dr Reinhard Mecke. Unter Mitwirkung von Dr. Anton Lambertz Pp. vi + 195 (Berlin: Julius Springer, 1926.) 9.60 gold marks.

This useful work is a reprint of the technical advice concerning physical lecture experiments given in the introductory volume of Geiger and Scheel's handbook of physics, which has appeared in 24 volumes. It describes 533 lecture experiments covering the whole range of physics. Many of these are new, and in all of them due consideration is paid to the modern resources at the disposal of the experimenter. This applies particularly to the thermionic valve. We notice elegant methods of demonstrating stream lines by means of coloured liquids, the Johnsen-Rahbek effect of friction due to small currents, experiments with the speaking arc, and some very pretty and ultramodern spectroscopic demonstrations. A valuable feature of the book is the addition of the essential definitions and formulæ, together with the chief numerical data As the work is not a text-book of physics, nothing but what is essential to the success of the experiments is given, and given in the smallest compass. But wherever desirable, references to original papers or text-books are appended. Altogether an admirable book.

The Caves of Mendip. By H. E. Balch. (The Somerset Folk Series, No. 26.) Pp. 82+18 plates. (London. Folk Press, Ltd., 1926.) 2s. net.

In this little book, which forms one of a Somerset Folk Series, the author, whose work in cave exploration has long been so well known in the west of England, gives a fascinating account of what he terms elsewhere the 'Netherworld of Mendip.' Some of the adventures described, such as those in the Lamb Lair, Harptree, and in Eastwater Swallet,

show that cave exploration may afford all the risks of mountaineering with the additional possibilities of getting drowned or wedged in a narrow passage. An impressive point is the evidence given of the existence of vast caves which have never yet been reached The cave to which most space is allotted is naturally Wookey Hole, and a few illustrations of the remains left by its Palæolithic and later inhabitants are reproduced from the author's larger work on the subject Other illustrations are from photographs by Mr. J. H. Savory, to whose keenness and skill all Somerset spelæologists owe so much The author points out that much work is in progress or remains to be done on the caves of the Mendips, and in this connexion allusion may be made to the admirable work carried out since the War by the Spelæological Society of the University of Bristol

Elementary Algebra By F. Bowman. Part 2. Pp viii+431. (London Longmans, Green and Co, Ltd, 1927.) 6s.

The second part of Mr Bowman's "Elementary Algebra" contains much of the modern analysis which is generally known as 'higher algebra.' Beginning with convergency and the usual series, he passes on to the complex variable and eventually discusses the fundamental theorem of algebra that every equation has at least one root. The consequence of this arrangement is to bring determinants, permutations, and combinations at the end of the book.

The treatment throughout is admirable, especially in the chapters on convergency and complex numbers. Geometrical illustrations are used in an instructive manner and care taken to clear up small points which create difficulties to beginners, e.g. on pp. 19 and 28.

It seems unnecessary to assume that students who are reading the algebra covered by this book will not be familiar with some analytical geometry and calculus, and the space given to these subjects might well have been used to give a fuller treatment of convergency and thus make the book more useful for those preparing for mathematical scholarships at universities.

Animal Mind. By Frances Pitt Pp. 340+22 plates. (London: George Allen and Unwin, Ltd., 1927.) 15s. net.

MISS PITT'S work is the modern version of the old anecdotal natural history which Edward Jesse and others made familiar to early-Victorian naturalists. But the new version is much revised and improved, for Miss Pitt's knowledge of the ways of common birds and mammals is deep, and in endeavouring to interpret habits and incidents she is seldom betrayed into the facile explanations which often satisfied the earlier writers. The observations are acute and reveal many striking facts well worth testing in a wider field, such as the response of the eating instinct of a young fox to the presence of a trace of fur, while plain flesh was ignored. The book is well adapted for the general reader as well as for the trained naturalist.

# Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

# Weber's Theory of Molecular Magnetism, and the Internal Field.

THE name of W. Weber is one of those outstanding continental names which are associated with epochs in the development of science, and are regarded with honour in Britain Yet in Britain there has been evident a considerable amount of misunderstanding regarding Weber's initiation of the essential features of the modern theory of molecular magnetism. That misunderstanding seems to have originated in an unfortunate wording of a remark made by Maxwell in his exposition and development of Weber's work "Electricity and Magnetism," vol 2, 2nd ed., p. 76).

The two essential features of the modern theory are clearly stated by Maxwell. First he says (p. 74): "Weber's theory differs from this in assuming that the molecules of the iron are always magnets, even before the application of the magnetising force." Secondly, he says (p. 76): "The molecules do not turn with their axes parallel to x (the direction of the magnetising force), and this is because each molecule is acted on by a force tending to preserve it in its original direction, or because an equivalent effect is produced by the mutual action of the entire system of molecules." It is the statement in the last clause which contains the second essential feature.

In addition, Weber adopted Ampère's view that the molecular magnetism results from molecular currents; and, to this view, modern physics has merely added the restriction that these currents

are convective.

In the first sentence quoted above from Maxwell, the first feature of the modern theory is explicitly ascribed to Weber: in the second sentence, the second feature is not directly ascribed to him. If that feature were not due to Weber, that sentence would, in accordance with the rules regulating scientific priority, fix it as the property of Maxwell and constitute him as the originator of one-half of the essential fundamental postulates of the modern theory. But Maxwell is making no claim for himself. In his next sentence he adds that "Weber adopts the former of these suppositions as the simplest.

This last remark clearly points out that Weber discussed the second feature. Therefore, unless he explicitly abandoned it, he was the originator of both of the basic postulates of the modern theory. Maxwell's words do not necessarily mean that Weber abandoned the second supposition. They only assert that he did not follow it out; and, further, that he did not do so because that supposition was not so simple as an alternative which was chosen by him.

Now the most minute search of Weber's paper (Pogg. Ann., 1852), word by word, reveals two facts-(1) Weber not merely, as Maxwell implies, asserts the second feature of the modern theory, he reiterates it again and again; (2) Weber not merely avoids any choice between that feature and another one, for reasons of simplicity or otherwise: he persistently avoids the consideration of any alternative.

Therefore he, and he alone, is the author of the

modern theory of molecular magnetism.

Moreover, Weber was not merely the originator of

the fundamental ideas. He was their first developer. No later worker can do more than apply his views Weber himself illustrated the applicamore widely tion of these views, in two cases, by a formal development of the action due to a neighbouring molecule; and that application constitutes one of those gems of intuitive insight which characterise the work of the masters.

Therefore Maxwell cannot, in the sentences quoted above, apart from a serious misunderstanding, be ascribing to Weber a choice between a non-magnetic force and one of magnetic origin. That is perhaps the most natural interpretation of his words, yet he does not explicitly mention a non-magnetic force any more than does Weber. That idea was introduced

by other workers.

Weber did make one choice, and that evidently for reasons of simplicity as Maxwell said, though he did not state them as such In speaking of the force which must be acting so as to drive back a magnet to its position of equilibrium when it has been deflected from it through an angle  $\phi$ , far from saying a non-magnetic force, he says, "But this back-acting force, arising from the inutual actions of the molecules, must increase with the deflection, and can be represented by  $D \sin \phi$ , where D denotes a constant magnitude which one can call the molecular directive

force" (p 166).

That is Weber's direct assertion in introducing the very expression for the resultant force with which Maxwell deals. Therefore, as above stated, Maxwell could not possibly assert or mean that Weber abandoned the view that the force had a source apart from the mutual molecular magnetic On the other hand, it is to be noted interactions that Weber's theory fixes the expression for the force whenever the distribution of the surrounding molecules is given. The thing that Weber definitely avoided, and that for the sake of simplicity alone, was the necessarily laborious evaluation of the true expression for the internal field. He took the only other possible method of approved scientific exploration, the method of postulation of a simple and sufficiently approximate expression for it. Maxwell, apart at least from an accidental failure to notice Weber's own statement regarding the nature of D, could mean nothing olse than that; but the wording of his statement can unfortunately lend itself to the other interpretation.

The incorrect supposition that Weber abandoned the idea of mutual interaction of the molecules by means of their magnetic fields alone has not been quite universal in Britain. Jeans, for example ("Electricity and Magnetism"), describes the correct

position with great clearness.

The later development of the subject by Ewing was largely directed towards the illustration, by means of models, of that mutual interaction of molecules which Weber first put forward, and against all postulates of the existence of quasi-clastic forces which had been made by certain other writers, amongst whom, however, Weber is not to be found.

The task of subsequent work is the evaluation of the force symbolised by D. Weber made the most drastically simplifying postulate regarding it. He assumed it to be constant, and found the result to be in agreement with observation in the case of soft iron: and he insistently reiterated the statement that he was dealing only with non-retentive iron. It was Maxwell who pointed out the over-stringent nature of Weber's postulate if retentiveness is to be taken into account, and he widened it accordingly. That was Maxwell's work, not Weber's, and in it he followed Weber in tentatively assuming a simple

form for the law rather than determining it by mathematical development, which the state of experimental knowledge at the time could scarcely

justify.

In the more recent development of Weber's ideas the question has been again raised whether the internal molecular magnetic field is sufficient to account for observed phenomena. Thus Weiss, who adopted Weber's assumption regarding the internal field to fit it for application to crystalline media, was led by thermomagnetic phenomena to ascribe very high values to the internal field relatively to even strong external fields. He afterwards pointed out that the high values may include equivalent values of fields which are actually non-magnetic, but may, for example, be electrostatic if the molecular magnet is also an electric dipole, and this view leads to values of the molecular electric susceptibility which are consistent with results of observation.

Now an application of Weber's theory to a determination of the actual law of force, due to the mutual actions of the molecular magnets in a homogeneous crystal, readily indicates that the magnitude of the internal field is of the same order as that of fields which are normally used in the investigation of the magnetic properties of substances. It shows, even without numerical evaluation, that the least possible value of an external field which is able to magnetise a cubic crystal in any direction relative to its crystalline structure is equal to five-eighths of the maximum That is to say, the maximum internal internal field field acting upon a molecular magnet is not twice as strong as the external field which is just able to turn the molecular magnets out of their stable directions, and so to magnetise the crystal in any direction. This is true whatever be the nature of the internal directive field which tends to maintain the magnets in their stable positions. If that internal field has in part an electrostatic origin, the remaining magnetic part is proportionately smaller

This is in accordance with the observations, described in a recent issue of NATURE (Mar. 5, p. 353), on the deflexion of  $\beta$ -particles in their passage through

thin magnetised nickel foil.

If we postulate that there is equipartition between the average translational energy per degree of freedom of the molecules and the average rotational energy of a molecular magnet, the axis of which is maintained, in consequence of the heat motions, on the average at an angle  $\phi$  with the direction of the resultant field, we find, on evaluation of the internal field, that, at ordinary temperatures, this postulate is not satisfied. The change of potential energy of a molecular magnet, due to the rotational effect of heat motions, amounts only to about 1 per cent. of the energy per degree of freedom. This seems to indicate that the internal structure of the molecule is such that, in the collisional interchange of energy amongst molecules, only about 1 per cent. of the whole is communicated to the subatomic portion of the structure which is concerned with the manifestation of magnetic quality. W. PEDDIE.

Univ. Coll., Dundee.

#### Evolution: Emergent and Resultant.

The recent articles by Dr. P. Chalmers Mitchell and Prof. C. Lloyd Morgan (NATURE, May 21, p. 748, and May 28, p. 786) clearly show the increasing importance of the problem of emergence. But it seems to me that Prof. Morgan advances a criterion of emergents which is seriously defective, and so

prevents any reconciliation of the opposed viewpoints. In the first place, he appeals to "matters as they now are," and quite apart from what future discovery may reveal. It follows, therefore, that as knowledge expands, much that is now regarded as emergent may prove to be resultant, since it will become deducible from the phenomena of some "earlier phase"; and to this progress no limits can be assigned in advance.

This attitude is plainly an appeal to the ignorance which prevails at any given moment, and it at once destroys any absolute distinction between the emergent and the resultant. Now the trend of research, in my opinion, undeniably involves this loss of absoluteness, as Dr. Chalmers Mitchell maintains For while it will always be impossible to deduce the macroscopic qualities of combinations from the macroscopic qualities of their elements, the more complete knowledge of microscopic and ultra-microscopic qualities does enable the qualities of combinations to be both explained and predicted. In this respect success depends on the capacity of the inquiring mind; so that as mind evolves, emergents must give way to resultants. If, for example, we accept Prof. Morgan's criterion, then to Galileo electromagnetic storms, due to solar radiation, would be emergent, while to us they are resultant. Similarly, many of the phenomena presented by vitamins, not being as yet deducible, are still emergent, but will probably be resultant for future bio-chemistry.

The criterion of being, or not being, deducible is thus wholly relative and transient; and it obscures what I take to be the sole genuine attribute of all emergents, whether deducible or not; that is, uniqueness, or the possession of characters previously unprecedented. From this more inclusive and unprecedented. permanent viewpoint, atoms and crystals emerged, exactly as did life and sentience at still later stages; and this quite apart from the partial, or complete, explanation of their origin. For each of these was, when it first appeared, in its own specific way unique, exactly as "Hamlet" would remain unique even though it could be fully accounted for in terms of Shakespeare's life and character. Such absolutely unique combinations occur, of course, throughout the entire universe, and present one of its most marvellous and significant features. So that although "out of three sounds he frame, not a fourth sound, but a star," still

A star's a star for a' that.

J. E. TURNER.

University of Liverpool, June 16.

IF there be a valid distinction between resultant and emergent advance the question arises: How may this distinction be expressed with precision and clearness? One way of expressing it is that developed by Dr. Broad. It comes to this. There are certain integral wholes, composed of constituents in specific relations, of which it may be said that their characterising properties are not deducible from the most complete knowledge of the properties of the constituents taken severally in isolation, or taken collectively in some other set of specific relations. Such a whole is said to be emergent The theory of emergence is on trial. Of it Dr. Broad says that "it is a matter of controversy whether it actually applies to anything"; but he adds that it embodies "a logically possible view with a good deal in its favour." If, then, the theory be on trial as a scientific proposition and such it purports to be-it must, I submit, be tried out on the basis of existing scientific knowledge. I should not designate this as an appeal to ignorance.

Dr. Turner suggests that, instead of saying that the emergent, as something distinctively new, is not deducible from the data afforded by our present knowledge of the old—the characterising properties of the living organism, for example, not deducible from our existing knowledge of not-living entitiesit would be better to say that the character of the emergently new is unprecedented. One should welcome any suggestion that may conduce to clearness and precision But some may ask in what respect the unprecedented differs from the not-deducible Has it a wider or a narrower reach? Were I to use the word 'unprecedented' it would have for me a wider reach, since there are quite possibly, and I think very probably, thousands of instances in which some given mode of the algebraical summation of resultant features has never occurred before, and is, in that sense, unprecedented. But if this be so, we have here no criterion of that which is emergent as distinguished from resultant.

It seems, however, to be Dr. Turner's opinion that whereas the notion expressed by 'not deducible' prevents any reconciliation of opposed viewpoints, the implication of 'unprecedented' may tend to further such reconciliation. What, then, is this implication? It may be such as Prof Alexander, Dr. Broad, and Prof Whitehead would gladly accept But we need a clearer statement of what unprecedented means and all that it means. In view of reconciliation, is there some implication, which Dr. Turner surmises may be taken for granted?

C. LLOYD MORGAN.

#### Adsorption Isothermals.

In his book "Colloid and Capillary Chemistry" (page 111 of translation by H. Stafford Hatfield, London, 1926) Freundlich remarks in reference to the adsorption of gases: "a theoretically well-founded equation, giving the a, p curves over a considerable range, is not known. The empirical general parabolic equation  $a = ap^{1/n}$  in which a and 1/n are constants, is still nearly always used." The quantities a and 1/n are functions of the temperature and are constant when this is constant.

Freundlich refers to the theoretical studies of Polanyi, Langmuir, A. M. Williams, and others, and quotes the equations for the adsorption isothermal which some of these workers have proposed.

One naturally hesitates to introduce another equation into the field, but feels encouraged to do so if the new formula appears more suggestive than the older ones. I have recently been much impressed by the manner in which

$$a = \frac{f(T)p^{T/273x}}{1 + \phi(T)p^{T/273x}}$$

agrees well with experimental observations in a variety of published cases. In this equation a has its usual significance, the amount adsorbed; T is the absolute temperature of the experiment; f(T) and  $\phi(T)$  are functions of T, being constant when the temperature is constant; p is the equilibrium pressure of the gas, or may be replaced by c, the equilibrium concentration, for cases of adsorption of solute from dilute solution. Clearly if  $\phi(T)$  is positive the amount adsorbed attains a saturation value, but if  $\phi(T)$  is negative it becomes infinite at a certain pressure.

The symbol x is of interest. It is often actually unity, and in all cases that I have so far examined, exceedingly good agreement with experiment has resulted when x has been given a low integral value, as shown by the following:

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Adsorption of carbon monoxide, argon, nitrogen on charcoal	x = 1
Adsorption of water vapour on)	x = 2 or multiple of 2
cotton, wood, leather	mumple of 2
Adsorption of acetone in water on blood charcoal	x = 2
Adsorption of bromine in water on blood charcoal	x = 2
Adsorption of isoamyl alcohol in water on blood charcoal	x = 4
Adsorption of benzoic acid in benzene on blood charcoal	x = 3

It should be noted that when the formula now proposed is substituted in Gibbs's adsorption formula.

$$a = -\frac{c}{RT}\frac{d\sigma}{dc},$$

we arrive at the following equation showing the effect of concentration on the surface tension of a solution:

$$\frac{\sigma_M - \sigma_L}{\sigma_M} = \frac{f(T)}{\phi(T)\sigma_M} R \cdot 273x \log \left(1 + \phi(T)c^{T \cdot 273x}\right),$$

which reduces to the empirical formula put forward by V. Szyszkowski (Zeits f. physik Chem., 64, 285; 1908) when T=273 and x=1.

Some years ago I had occasion to make measurements of the absorption of radiant energy from a stream of full radiation, temperature  $373^{\circ}$  absolute, by gases and vapours, and obtained data, more complete than any found published at the time, showing the variation of the proportion of the energy absorbed with the pressure of the absorbing gas in a column of constant dimensions. The equation suggested in the preceding for the adsorption isothermal can be applied with success in this case; T is the temperature of the radiation, p is the pressure of the absorbing gas, a is the energy absorbed, x=1 for carbon dioxide, benzene vapour, x=2 for water vapour. It is not difficult to conceive a relationship between the phenomena of adsorption and of radiation absorption.

The nature of my employment does not permit me to devote much more than my lesure hours to a study of this kind, and I shall be glad to communicate to any interested worker who may have facilities to pursue the matter both experimentally and theoretically, such results as I have, so far, been able to accumulate.

H. Bradley.

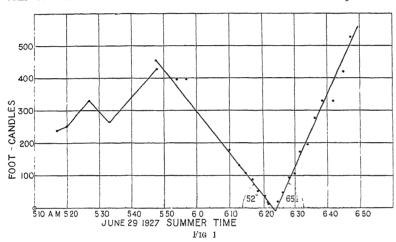
The British Boot, Shoe and Allied Trades Research Association, 19 Bedford Square, W C.1.

#### The Mechanism of Enzyme Action.

For a long time two viewpoints regarding the mechanism of enzymatic activity have profoundly influenced our conceptions in this field. To Oscar Loew is due the credit for the original suggestion that the enzymes possessing atomic groups with kinetic lability are able, even at a comparatively low temperature, to perform chemical action. This suggestion was later abandoned more and more, and we now generally assume that, as in the case of heterogeneous reactions, the reactants are adsorbed by the enzyme in order that reaction may ensue. In accordance with this we believe with Bayliss that the reaction velocity is determined by the concentration of adsorption complex, that is, reactant—enzyme, present in the system. The possibility of carrying out such reactions depends doubtlessly on certain conditions of the surface, which are also profoundly influenced by the hydrogen ion concentration.

Preliminary experiments carried out with certain zymase solutions which behave as lyophile colloids confirm this assumption. The reactivity of these solutions could be increased in such a manner that in laboratory tests the first stage of the reaction of zymase, for example, on glucose, produces 4, 5, and more c.c. of carbon dioxide per minute, so that a cell-free zymase solution can easily be prepared which will produce (using 20 c.c of the zymase preparation containing 5 per cent. of the substrat) 100 c.c or more of carbon dioxide in less than one hour. Similar effect of increased production of oxygen was obtained by the decomposition of hydrogen peroxide by means of catalase from fresh tobacco leaves.

The reactivity of the surface of the enzymes concerned in this reaction may be tremendously increased by appropriate peptisation, and the velocity of the reaction later undergoes a decrease which cannot be due yet to the decreasing concentration of the reactant Further experiments have shown that this capacity to react in an intensive manner can be maintained, within certain ranges, in both cases by working with living cells or with the colloidal cell-free solutions. The



experiments carried out indicate that certain chemical compounds are capable of forming an adsorption film on the surface of the enzymes which has the rôle of a protector (F. F. Nord, Protoplasma, 2, No 2; 1927). It might thus be assumed further that certain compounds which are supposed to have the effect of an 'activator' of an enzymatic reaction are in reality not activating the reaction, but only insufficiently protecting the enzyme from the damaging effect of intermediate or final metabolic products of the reactions concerned. It might be regarded, therefore, as correct to assume that regardless of the absence or the presence of a protector, which might even be a specific protector, there is always a certain concentration of enzymes present which is potentially capable of acting However, since the reactivity of the enzyme is dependent on its surface activity, it undergoes immediately with the initial reaction alterations which decrease relatively the velocity of the reaction independently of the concentration of the reactant In the course of the reaction the ratio between active and 'damaged' enzyme may decrease more and more below 1. Our present experiments have shown that it is possible to delay the speed of the reaction reflected in the change of the quotient noted above.

Since the most favourable conditions for the performance of an enzymatic reaction are in most cases not known, the statements above suggest the conclusion that in a great number of so-called 'activations' of enzymatic reactions by means of chemical compounds, in fact no 'activation' takes place by influencing enzymatic reaction through these com-

pounds, but the so-called 'activators,' which appear to be really protectors, enable the enzymes to act under conditions which are more nearly those which might be expected to be prevalent in ideal cases

The experimental work has been carried out in collaboration with Kurt W Franke. The details will be prepared for publication in the near future.

F. F NORD.

Division of Agricultural Biochemistry, University of Minnesota, April 12

# Photometric Measurements during the Total Solar Eclipse.

It occurred to me that it would be interesting to measure the illumination received by a horizontal surface exposed to the hemisphere of sky during the whole period of the eclipse

I had the good fortune to see the eclipse from a large flat field to the south-east of Bankfield There were Southport. Lane, some distant low houses to the north-west, and some distant trees to the west-south-west, but for the purpose in question it may be assumed that the white test surface, placed six inches above the ground, was exposed to the hemisphere of sky, except for the obstruction of light caused by my crouched body This was allowed for before the results were plotted (Fig. 1). The readings were taken by means of a daylight photometer (a lumeter).

Practically the whole of the sun's disc was visible for the whole of the time, but there was a haze all the time. Sometimes this haze was noticeably thicker, but for-

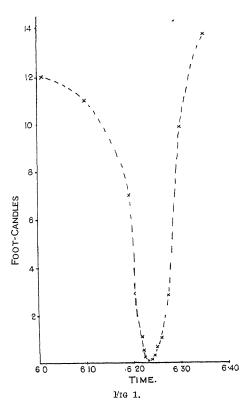
tunately this variation occurred towards the beginning and end of the readings. The regularity of the readings from 5.48 A.M. (with the exception of 5.57 A.M. when the haze was noted) to 6.47.5 A.M. seems to show that the haze must have remained constant during that period. My position when reading was north-east of the test surface, so that the direct sunlight was screened from the surface

It will be seen that the two inclined lines intersect at 6.24 A.M. (mid-totality), and that the line of decreasing illumination makes an angle of 52° with the horizontal, while in the case of the line of increasing illumination the angle is 65.5° This is due to the greater elevation of the sun during the latter period.

Several accounts of the eclipse refer to the "sudden switching off of the light at totality." This does not seem to be borne out by the curve. It was also thought by many that the light after totality was much greater than before. The curve does support this impression to some extent, but probably most of it was due to the physiological effect of the eye (pupil and retina) adjusting itself gradually to the decreasing light and then suddenly receiving the bright light after totality.

For the convenience of readers when studying the curve, it may be mentioned that at Southport on June 29, the sun rose at 4.47 A.M. Summer Time, first contact occurred at 5.30 A.M. Summer Time, and last contact at 7.21 A.M. Summer Time.

A S. E. ACKERMANN. 17 Victoria Street, S.W.1. The appended graph (Fig. 1) records the intensity of daylight during the recent total eclipse at Criccieth. The measurements were made by a Trotter photometer set up to face that part of the clouds which hid



the sun from Mr. A. Taylor and his colleagues at the observing station there.

The sudden onset and retreat of the darkness is well shown. The minimum recorded intensity (at  $6^{\rm h}$   $23^{\rm m}$ ) was 0.05 foot-candle, so that in 7 minutes after totality the intensity of daylight increased more than 270-fold.

J H. SHAXBY.

Physiology Institute, University College, Cardiff.

#### The Hythe Skulls.

I am gratified by the letter of the editor of Biometrika in Nature of July 2, which suggests, though it does not say, that Miss Hooke did not mean to hint that I had wilfully selected certain skulls from the Hythe collection and discarded others which did not suit my purpose. This disclaimer was urgently needed. The suggestion of the editor that only the largest and thickest skulls had been picked out of the stack in 1851 is rather irrelevant, since the question of size is not the point.

What anthropologists who have quoted my paper are interested in is whether these skulls are broader and shorter than any other series of medieval or modern English people shows, and I submit that an average based upon 590 skulls, so long as the imputation of purposive selection is withdrawn, is not likely to differ appreciably from that of a like number recovered since. The question of whether it is advisable to deduce results from skulls which have been reconstructed from fragments, possibly crushed

and warped with damp, is quite an open one. In my experience the results are often grotesque caricatures of the original skull, and measurements taken from them are more likely to vitiate than to improve a fair average. In any case, the estimate of five years in which to piece together the fragments in the great stack at Hythe shows an optimism which, though I may admire, I cannot share. It might be done in fifty years, but the results would be quite untrust-worthy. Any one interested in these skulls will find a later paper of mine upon them in Archwologia Cantiana, vol 30, p. 203, in which I give my reasons for believing them to be largely of foreign origin, though I freely admit that in my first paper I assumed them to be those of Kentish people

F G. Parsons.

St. Thomas's Hospital, London.

#### "Index Kewensis."

I UNDERSTAND that it is not generally known that the Sixth Supplement of the "Index Kewensis" was published last year by the Clarendon Press. This includes references to the names of genera and species of flowering plants which were published during the five years 1916–1920, and also includes many which had appeared in previous years in publications which, owing to the War, were not available at Kew

As I have been informed that many sets of the "Index Kewensis" in botanical and horticultural libraries appear to be incomplete, and that in some cases supplements have been purchased for libraries which do not possess the original volumes, I have been asked to direct attention to the importance of the work. I would also point out that it is necessary, in order to keep abreast of botanical nomenclature, to possess all the supplements which have been published as well as the original "Index." Copies of the original "Index" or of any of the six

Copies of the original "Index" or of any of the six quinquennial supplements may be obtained from the Secretary, The Clarendon Press, Oxford.

ARTHUR W. HILL.

Royal Botanic Gardens, Kew, Surrey, June 24

#### An Early Reference to Continental Separation.

Those geologists who are interested in the Wegener hypothesis of the shifting of continents and the liters are of the subject may like to know that while reading an old book entitled "Eclipses, Past and Present," by the Rev. S. J. Johnson (James Parker and Co., 1874), I was rather surprised to find the following remarks: "If we study our earth carefully, we shall see that everywhere it bears marks of having undergone a fearful catastrophe. Fossil substances, which originally belonged to the sea, have been found on the heights of mountains; the bones of animals have been discovered in countries the most remote from those they inhabit. Again, if we look at our maps, we shall see the parts of one continent that jut out, agree with the indented portions of another. The prominent coast of Africa would fit in the opposite opening between North and South America, and so in numerous other instances. A general rending asunder of the world would seem to have taken place..."

I have italicised the important words.

W. WRIGHT.

24 Balham Park Road, S.W.12

# Stone Age Man in Kenya Colony.

By L. S. B. LEAKY.

In September 1926 I sailed from England accompanied by Mr. B. H. Newsam to investigate certam prehistoric sites which I had known of for some years in Kenya Colony. My expedition received financial aid from the Percy Sladen Memorial Fund and the Government Grant Committee of the Royal Society, the assistance of which is gratefully acknowledged. Stone tools of many types had been collected by myself and many others from the surface in Kenya Colony and the other East African territories for a good many years, and it was hoped that the work of the expedition this year would bring to light sites contaming stone tools associated with human remains

This expectation has been more than justified, as the following details will show, and it is hoped that the finds which have been made will prove suffi-

ciently important to call forth more extensive financial assistance, so that work may be continued in 1928 on a more comprehensive scale. A large number of further sites of great promise have been located. Until the specimens obtained have been brought to England and submitted to experts and carefully examined and compared with other prehistoric remains, it is naturally undesirable that I should make any definite statement as to the racial or cultural affinities of my finds, so the following general statement and outline must for the present suffice.

#### THE NAKURU SITE.

The first site excavated which yielded important results was situated on Major Macdonald's farm, Nakuru. Traces of ten burials were found in the lower levels of the deposit at depths ranging from 8 ft. to 12 ft. The majority of these human remains were veryfragmentary with the exception of Skull No. 3 and Skeleton No. 9, which was in an almost perfect state of preservation. This find was reported in the *Times* of Dec. 28 last. All the human remains found were definitely associated with a microlithic industry which I consider Mesolithic, and which bears striking resemblances to that industry in Uganda which Mr. Wayland has named Magosian. No attempt has been made to classify the tools out here, but this will be done immediately on arrival in England.

The skulls from the Nakuru site (see Fig. 1) do not resemble the skulls of the modern negro races inhabiting this country; nor, apart from extreme dolichocephaly, do they show any of the more marked characters usually considered typical of existing negro or negroid races. The face, instead of being short, is very long, but is not disharmonic

as it is proportionately broad, giving an upper facial index of 571. The nasal opening is only of medium width, the nasal index being 509. The nasal bones are long and are not flattened as in typical negroes, and there is a medium bridge. The lower margin of the nasal aperture has a well-defined sill and not the groove so common in negroid skulls

The mandible is remarkable in several respects. The horizontal ramus is very deep, especially in the region of the chin, which is very pronounced. The ascending ramus is also very high. This is largely due to, and necessitated by, the great height of the vault of the palate, which—measured from the chewing surface of the second molars—is 29 mm. This is remarkable, being as great a height as that recorded for Rhodesian man by Sir Arthur Keith ("The Antiquity of Man," vol. 2, p. 400). This

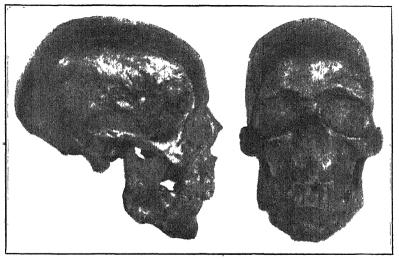


Fig 1.—Side and front views of Skull No. 9 from the Nakuru site.

measurement is given as being 7 mm. more than in the average English palate, while the average palate depth of six negro skulls measured locally is only 16.08 mm.

# THE ELMENTEITA SITE

The other site from which important results have been obtained is on Mr. Monroe's farm, Elmenteita. From this site the remains of at least twenty-six stone-age individuals have been recovered. The site is situated at the base of a small cliff below which there now runs a small stream. The bones were found in an alluvial sand, and were in a very disturbed state, being all mixed up and not lying in skeletal form. Five or six long bones, all femurs, for example, would be found lying in the same sand-filled crevice. Skull fragments and mandibles turned up in all sorts of odd corners with, here and there, pottery fragments and tools. It is at present difficult to account for this state of affairs, and the pros and cons of the various possible theories must be held over until a future date.

In the deposit with the human remains were found a number of obsidian tools mainly of a more primitive type than those from Nakuru, but including a few lunates and other Nakuru types. There was also a certain amount of pottery, some of it with the same decoration as found on the Nakuru examples, numerous animal bones, including skulls, mandibles, and teeth; disc shell beads, and one stone bowl similar to one of the Nakuru types.

At first it was thought that the skulls from the two sites were of the same type, but this is not substantiated by a close comparison made recently, although there are certain similarities. It is even doubtful if all the skulls from the Elmenteita site will prove to belong to the same race. Nevertheless, all the mandibles from this site show common characters, while they differ markedly from the Nakuru mandible

Skull A from Elmenteita is certainly different from Skull No. 9 from Nakuru. The photographs

graph. The similarities lie in the length of the skull as compared to the breadth, the cranial indices being 68·2 (Elmt) and 69 8 (Nak), the upper facial length, which is 80 mm. in both specimens, and the bi-zygomatic breadth, which in each case is greater than the maximum skull breadth, being 136 mm. (Elmt.) and 140 mm (Nak.)

Another skull type found at Elmenteita has a much broader skull, giving a cranial index of 76 It has a good forehead, and is orthognathous. This type, however, also differs from the Nakuru type.

Perhaps the most surprising feature of the Elmenteita crania is the narrowness of the nose as compared with the length. The four specimens upon which it is possible to take measurements yield the following results.

	Lengan	Bieautn	Tude z
Skull 'A'	$59~\mathrm{nun}$	$28~\mathrm{min}$	47 4
Skull 'B'	$60 \mathrm{mm}$ .	$24 \mathrm{\ mm}.$	40
Skull 'C'	$50 \mathrm{mm}$ .	$22~\mathrm{mm}$	11
Skull 'D'	$50 \mathrm{\ mm}$ .	$22~\mathrm{mm}$	44

These figures are certainly not those suggestive of negro affinities It seems doubtful even if those Negroid races which to-day have narrow noses can approximate to these figures

Full details of the work done and objects found will be published as soon as possible after our return to England in September with this season's specimens.

In Nature for Jan. 8, p. 61, there is a short note on my work based on a report in the *Times* of Dec. 28, 1926. This note contained some maccuracies and I would be grateful if I may be permitted to correct two of them. I am referred to as " of the Cutler Dinosaur Expedition" I am not a member of this expedition, nor, so far as I know, has

an expedition under such name existed out here. In 1924 I had the honour of being, for one year, a member of the British Museum East Africa Expedition which was excavating for Dinosaur remains in Tanganyika Territory under the leadership of the late Mr Cutler. Further on, reference is made to my "work in investigating stone-age remains in Uganda." Nairobi and Nakuru are towns in Kenya Colony, and it is regrettable that the archæological work in the two countries should be confused.

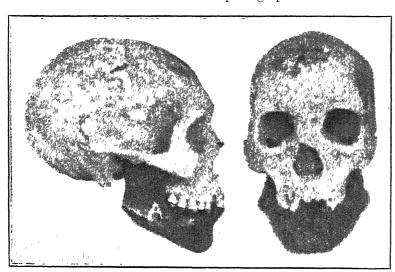


Fig. 2 —Side and front views of Skull A from the Elmenteita site

(reproduced as Figs 1 and 2) show both the similarities and the differences. In the Elmenteita skull the forehead is low and receding; the nose is much longer than in the Nakuru skull, while the width is much the same, this resulting in a lower index, which is actually 47.4. Moreover, instead of a sill at the base of the nose there is a groove; there is a trace of sub-nasal prognathism, the alveolar index being 103, the height of the vault is nothing like so great, while the mandible is of a quite different type. This is amply brought out in the photo-

# Some Difficulties in Relativity.

By Prof. S BRODETSKY, University of Leeds.

THE special theory of relativity was formulated by Albert Einstein twenty-two years ago. The general theory with its application to universal gravitation was published eleven years ago. The relativistic viewpoint has become an accepted principle and instrument in physical science. Yet

a complete understanding of the ideas underlying it is comparatively rare among laymen, and far from being universal even among men of science. This is natural, since the theory of relativity presupposes a break with preconceived notions, hallowed by unquestioning acceptance at the hands

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of untold generations of experience and thought. We shall in this article consider a few of the difficulties that have come to the notice of the writer.

At bottom, the cause of all the difficulties assocrated with the special theory is the fact that the signals, which we have used from time immemorial for the purpose of correlating events at different places, travel so fast that it only became possible quite recently to measure their speeds. sound travels much faster than anything experienced in actual life until a few generations ago Light travels so fast, indeed, that to many people it is still a matter of surprise to hear that it is not instantaneous in its effects. Our primitive conceptions of time and space are therefore such as correspond to an infinitely fast signal, and a readjustment of ideas is required in order to reach conceptions of time and space that correspond to a signal that travels with finite and measurable speed.

Thus it appears to some people somewhat arbitrary to lay down the postulate that in empty space (infinitely far removed from the influence of matter) the speed of light must be the same to all observers, no matter what velocities they may have relatively to one another. Not everybody can visualise readily two frames of reference and argue from one to the other. Perhaps the argument will appear simpler if put as follows.

It is as much a fundamental of classical mechanics as it is of relativity mechanics that we cannot discover the absolute motion of a material body. Modern astronomy has long since discarded such views as the fixity of the centre of the earth, or of the centre of the sun, or of the centre of mass of the solar system, or of the centre of mass of the stellar system in which we live. We cannot say, therefore, what is the absolute motion of any material body, such as a long bench. Take two points, AB, fixed on this bench: Can we correlate the times at these two points? This is only possible by sending a signal from A to B. If Asends out this signal at, say, ten o'clock on his watch, B receives the signal and knows that it is then ten o'clock to A

The signal, however, takes some time to go from A to B, and naturally B will make a correction for this by saying that he receives the signal later than it leaves A, the delay being the distance AB divided by the speed of the signal. Now the bench AB is itself in motion in a manner which is quite unknown. Suppose that it moves with velocity u from A to B: then the speed of the signal relative to AB will be diminished by this amount, so that if its absolute speed is c the delay between A and B is AB/(c-u). But u is unknown. Hence the delay is unknown, and we reach the conclusion that it is quite impossible to correlate the times at A and at B!

We refuse to accept such a conclusion, because it destroys the basis of all natural knowledge. There are only two ways of escaping this conclusion. One is to suppose that c is infinite; the other is to assume that the speed of the signal relative to the bench is quite independent of the motion of the

bench, so that if this speed is called c, the delay is always  $AB \cdot c$ 

Now even if we could imagine or postulate a mystical signalling agency which travels with infinite speed, we must remember that scientific observations are made with the aid of instruments like telescopes and microscopes, which presumably cannot philosophise, and can only register events as impressed on them by natural agencies. All our observations, whether directly or with instruments, depend upon visual or optical coincidences (sound is never used for really accurate measurements). We are therefore forced to postulate that light travels with a finite speed which is independent of the motion of the observer. Further, we must restrict this postulate to light, and accept that other speeds are affected by the motion of the observer . otherwise we would come into conflict with common experience Besides, the convection coefficient  $1-1/\mu^2$ , which gives the amount by which the speed of light in a medium like water (refractive index  $\mu$ ) is affected by the motion of the medium itself, is a direct proof that the fundamental speed which remains unaffected by the motion of the observer is indeed the rate at which light travels in a vacuum.

Another difficulty that has been mentioned is the following. According to relativity, apparently, if an interval of time is measured by two observers A and B, then the value obtained by A will bear to the value obtained by B the ratio  $(1-v^2/c^2)^{-\frac{1}{2}}$ , where v is the velocity of B relative to A. But the velocity of A relative to B is -v, so that the value obtained by B should also be  $(1-v^2/c^2)^{-\frac{1}{2}}$  times the value obtained by A. This sounds absurd, and is reminiscent of the rather tantalising game with paradoxes that exponents of relativity used to include in before admiring and bewildered audiences. But consider the facts carefully.

The Lorentz transformation is:

$$x' = \frac{x - vt}{(1 - v^2/c^2)^{\frac{1}{2}}}, \quad y' = y, \quad z' = z, \quad t' = \frac{t - vx/c^2}{(1 - v^2/c^2)^{\frac{1}{2}}},$$

where (x, y, z, t) refer to A, and (x', y', z', t') to B, the direction of the relative motion being along the x, x' axes. Hence we get

$$\begin{split} \Delta t' &= \frac{\Delta t - v/c^2 \cdot \Delta x}{(1 - v^2/c^2)^{\frac{1}{2}}}, \\ \frac{dt'}{dt} &= \frac{1 - v/c^2 \cdot dx/dt}{(1 - v^2/c^2)^{\frac{1}{2}}}. \end{split}$$

The ratio of the intervals dt, dt' thus depends also on dx/dt. If dx/dt is zero, we get  $dt'/dt = (1 - v^2/c^2)^{-\frac{1}{2}}$ . But now let dx/dt = v; then  $dt'/dt = (1 - v^2/c^2)^{\frac{1}{2}}$ . Whereas in the first case we measure an interval between events at a place fixed relative to A, we are in the second case measuring an interval between events at a place fixed relative to B. There is no inconsistency; the results are in fact consistent and logically correct.

A further difficulty arises in a similar way. If B have velocity v relative to A, then both x' and t' in terms of x and t have the same factor  $(1-v^2/c^2)^{\frac{1}{2}}$  in their denominators. Hence it would seem that

any velocity ought to appear the same to both A and B!

The fallacy lies in arguing from

$$x' = (x - vt)/(1 - v^2/c^2)^{\frac{1}{2}}$$

with t = 0, and from

$$t' = (t - vx/c^2)/(1 - v^2/c^2)^{\frac{1}{2}}$$

with x=0, and then applying the two results, obtained for different conditions, to a velocity, in which the length and the time refer to the same conditions. The correct procedure is thus:

$$\frac{dx'}{dt'} = \frac{dx - vdt}{(1 - v^2/c^2)^{\frac{1}{2}}} \bigg/ \frac{dt - vdx/c^2}{(1 - v^2/c^2)^{\frac{1}{2}}}$$

$$= \frac{dx - vdt}{dt - vdx/c^2} = \frac{dx/dt - v}{1 - v/c^2 - dx/dt}.$$

In order to get dx'/dt' = dx/dt we must have

$$\frac{dx}{dt}\Big(1 - \frac{v}{c^2}\frac{dx}{dt}\Big) = \frac{dx}{dt} - v$$

which leads to (i) v=0 or (ii)  $dx/dt=\pm c$ . (1) is trivial; (ii) means that only the speed of light is the same to both observers.

In the general theory of relativity very few persons attempt to follow the reasoning that establishes the equations of the gravitational field, and most people are prepared to take for granted the definition of  $ds^2$  in terms of the differentials of the four space-time co-ordinates. Where they begin to see 'physical' arguments is in connexion with the statement that the path of a particle of very small mass must be a 'geodesic' in the space-time continuum thus defined. The following difficulty has been raised: "It is said that the nearest way from any place to any other place on the earth is by following a geodesic. Surely this is not the case, for the nearest way is through a tunnel cut in a straight line."

It is an unfortunate fact that the best examples of geodesics are in connexion with curves on surfaces. These examples are therefore invoked in order to bring nearer to the minds of laymen the notion of geodesics in general. The effect is seen in the puzzle just quoted, and in the conclusion reached by the questioner: "Einstein's idea of space seems to be that which a fly might have walking round inside a glass globe."

When we talk about a geodesic on a surface, then we postulate a being that is restricted to moving about on the surface, and is physically and constitutionally incapable of getting away from the surface. The being may have intellectual knowledge of points off the surface, but such points are outside its physical or dynamical ken. Thus a tunnel through the earth is simply irrelevant to the question of geodesics on its surface. This is in actual agreement with life, as tunnels which are of such a length as to produce shortening of the path relative to the geoid are outside the domain of the practical, and all tunnels in use are constructed for the purpose of keeping as close as possible to the geoid and realising the geodesics on it.

Simplification, however, does not always lead to intelligibility, and it is doubtful whether the non-mathematical student of relativity is well advised to envisage geodesics on a surface, in order to understand geodesics in the four-dimensional space-time continuum. Consider rather geodesics in three dimensions in the following sense. In modern practical life time is often more important than distance, the former being endowed with an economic cash value denied to the latter. If A, B are two points in space, how can one go from A to B in the shortest possible time  ${}^{?}$  If the space is empty, and there are no aids or hindrances in the form of accelerative forces or resistances, intuition tells us that the geodesic (in the time sense) is what we ordinarily call the straight line joining A to B in empty Euclidean space. But now suppose that the space contains aids and hindrances to the motion. Suppose, for example, that between A and B there is a slab of matter through which the motion is necessarily slower than in the empty space. Then one needs no mathematics to see that unless the slab has plane parallel faces perpendicular to the line AB, the geodesic is not the straight line AB. The path of a ray of light in passing obliquely through a thick plate of glass is a relevant and clear example Still more striking is the path of a ray through a prism. The time taken by the light in travelling between two points, one on each side of the plate or prism, is less than what would be required for any other path between these points, and deviating only slightly from the actual path.

The advantage of considering geodesics in three dimensions is two-fold. In the first place there are no 'tunnels' to distract attention. In the second place it is not very difficult now to conceive that the four-dimensional space-time continuum has varying properties from place to place, so that a geodesic would not in general be straight as understood in the empty space of Euclid. The path of a particle would thus be curved, as viewed from the standpoint of empty Euclidean space, and it is not difficult to see that the natural paths may be, say, circular or elliptical, or in accordance with the more complicated results of

the general theory of relativity.

This brings us to the last difficulty which we shall discuss here: it is in connexion with the bending of light rays which are affected by the sun's gravitational field, or rather by the properties of the space-time continuum in the neighbourhood of the sun. Can this not be attributed simply to the attraction exerted by the sun on the light since we now know light to have both corpuscular and wave properties? It has been argued that even if the observed deflexion is found to be double that given by Newton's law of gravitation in accordance with classical mechanics, yet one might "doubt whether such a calculation is possible until we know the size and mass of the corpuscular element of light with the same degree of accuracy as we know the size and mass of electrons."

The fact is, of course, that the deflexion that would be obtained on the basis of the Newtonian

theory is quite independent of the size and mass of the hypothetical corpuscular element of light One might indeed invent some modification of the classical Newtonian theory so as to obtain the observed deflexion. But there is surely no point in postulating a theory which does not exist, in order to avoid accepting a theory which sums up in a remarkable manner so many of the laws and phenomena of mechanics, astronomy, and optics.

We all love sensations, and recently a prominent daily newspaper published a column about an alleged forestalling of Einstein by a German astronomer, who a century ago calculated the deviation of a ray of light on the basis of Newton's law of gravitation and the corpuscular theory of light. The formula there given is actually a correct deduction from the inverse square law, but when it is worked out numerically the result is just half of Einstein's value, and of the average value obtained at the eclipses in recent years. The relativity theory of gravitation not only 'explains' gravitation in the sense of representing it as a deduction from reasonable views of the space-time continuum, giving as a first approximation the Newtonian inverse square law, but also yields just the correction required to account for the observed motion of Mercury, and further gives a deflexion of light rays passing near the sun in agreement with observed fact.

# Obituary.

#### MR A. D MICHAEL.

THE debt which natural science owes to the work of amateur microscopists has often been commented on. Not a few names of weight in systematic zoology are those of men who turned a fascinating hobby into a serious study, and by patient and prolonged observation acquired a familiarity with the living creatures that the professional zoologists often have cause to admire and envy.

Of this type was Mr. A. D. Michael, well known as an authority on the mites (Acarina), whose death at an advanced age was recently reported. Not only did he produce admirable systematic monographs on several families of the group, but also he was successful in unravelling many details of their often complicated and puzzling lifehistories. Together with his wife, who assisted in all his researches, he acquired remarkable skill in minute dissection, and his accounts of the internal anatomy of many forms will not soon be superseded. One of his most interesting discoveries concerned the forms known by the name Hypopus, which are minute, hard-shelled mites with vestigial mouthparts, found attached to various winged insects by Their nature had been the means of suckers subject of a great deal of discussion, but by patient observation and experiment Michael was able to show conclusively that the Hypopus is an alternative developmental stage in the life-history of various Tyroglyphidæ (the family which includes the cheese-mite) adapted to secure the dispersal of the species.

Mr Michael was born in London in 1836. He was educated at King's College, London, and became a solicitor, succeeding to his father's practice. He seems to have taken up microscopy shortly after his marriage in 1865, but his first published paper on the Acari appeared in 1878 His later publications, some fifty in number, appeared mainly in the Journal of the Royal Microscopical Society, the Journal and the Transactions of the Linnean Society, and the Journal of the Quekett Club. Nearly all of these were finely illustrated by his own pencil, as were also his monographs of the British Oribatidæ (2 vols., 1883, 1888) and British

Tyroglyphidæ (2 vols, 1901, 1903) published by the Ray Society. In 1898, he contributed a revision of the Oribatidæ of the world to "Das Tierreich." He was in succession president of the Quekett Microscopical Club (1885–87) and of the Royal Microscopical Society (1893–96), and vice-president of the Linnean Society (1896–1900). Shortly before his death he presented his large collection of finely prepared microscopic slides of Acari to the British Museum (Natural History) and his microscopes to the Royal Microscopical Society. He died in a nursing home at Bournemouth on June 16 last W. T. C.

An appreciation by C. Hart Merriam in Science of April 8, of Dr William Henry Dall, reminds us that by the death of this veteran conchologist on Mar 27 last, zoology is deprived of one of the last remaining naturalists of the old school. Although chiefly known as a student of the Mollusca, Dr. Dall's activities were by no means confined to this group, his papers and monographs on a variety of subjects all ranking high in scientific literature His earlier work was chiefly on the natural history of Alaska, which he visited as one of the scientific staff, and later as head, of the Western Union International Telegraph Expedition. Besides exploring and mapping much of the Yukon River, he found time for observations on birds, fishes, and whales, the results of which, as well as geographical works on Alaska, were all published before 1880. From 1871 until 1874, Dr. Dall was surveying the Aleutian Islands and adjacent coasts; from 1880 until his death he was honorary curator in the National Museum, and palæontologist of the United States Geological Survey from 1884 until 1925. From 1893 until 1927 he held the chair of invertebrate palæontology in the Wagner Institute of Science, from 1899 until 1915 was honorary curator of the Bishop Museum, Hawaii, and m 1899 again visited Ālaska with the Harriman Alaska Expedition as one of the scientific guests. Dr. Dall's unique experiences thus render his works peculiarly valuable, whether he is remembered as a zoologist, palæontologist, or explorer.

# News and Views.

The appointment is announced in the London Gazette of a Royal Commission on Museums and Galleries under State control in London and Edinburgh. The announcement is a welcome indication of the interest of the Government in the great national collections for which it is responsible. For many years the majority of the twenty institutions named in the terms of reference has each pursued its own course unhampered by consideration of the development of sister institutions, and now the promise arises of a means of unifying efforts and correlating activities, which cannot but result in benefit to the institutions themselves and particularly to the public which supports and makes use of them. The need for such an investigation has recently been strongly urged in NATURE by Sir Ray Lankester, and also in a leading article in our issue of April 16 The Commission is a strong one Every member has had wide administrative experience: finance is specially represented by the Lord D'Abernon (chairman) and Sir Thomas Heath: artistic interests by the chairman, Mr. Evan Charteris, Sir Martin Conway, and Sir Robert Witt; education and the libraries by Sir George Macdonald and Dr. A. E. Cowley; the buildings in which the properties are housed by Sir Lionel Earle; and science by Sir Richard Glazebrook and Sir Henry Miers, the last of whom was himself at one time an assistant in the British Museum (Natural History). It is unfortunate that the Commission includes no one intimately qualified to weigh the evidence from the biological sciences, although they must occupy a large part of the inquiry, since they cover most of the Natural History Museum at South Kensington, the Royal Botanic Gardens at Kew, a large section of the Royal Scottish Museum, and the Royal Botanic Garden in Edinburgh, the name of which, surely by some slip, does not appear in the terms of reference.

IT is interesting to notice that in this official announcement the present clumsy title of the "British Museum (Natural History)" is simply replaced by "Natural History Museum"—a change long since advocated in these pages. The terms of reference are of the widest character. They include an inquiry into the legal position, organisation, administration, accommodation, and structural condition of the buildings and general cost of the institutions; an investigation of the past growth of the collections and estimate of the probable growth in the next half-century. Consideration is to be made of possible means of lightening the financial burden upon the taxpayer, either by curtailing expenditure or by instituting a more general system of entrance fees The questions of duplicate specimens and their distribution by sale or loan to provincial museums; of better correlation between the exhibits of the State institutions; of hampering conditions attached to benefactor's bequests and the possibility of their removal or modification, are all specified as part of this comprehensive inquiry. An exceedingly important clause, which may well lead

to a turning-point in the history of British national museums and gallenes, reads. "to consider whether the existing administrative responsibility for the various institutions is the most appropriate under modern conditions and whether it conduces to the most advantageous distribution and display of the national treasures, and to report whether it would be desirable, while preserving certain defined powers to their Trustees or Directors, to place them all under some central authority or under different authorities than those at present controlling them." The terms of reference treat the national collections as educational units isolated from and independent of the rest of the educational system of the country. The position is a mistaken one; it is to be regretted that no hint is given of a desire to bring museum and art collections into active and responsible connexion with the great teaching institutions which lie outside the control of the State.

The King of Spain has presented to the Natural History Museum, South Kensington, a group of Spanish ibex (Capra pyrenaica victoriæ) from Sierra de Gredos, Avila, Spain. It is a new race which was named by Prof. A. Cabrera after the Queen of Spain. The group, which consists of a male, female, and young, was mounted and realistically arranged in its natural rocky surroundings by Senor Lius Benedito, of Madrid. and the case containing it has been placed in the Central Hall, immediately facing the entrance. These specimens are the first of the race to be received at the Museum and form a valuable accession to the collections. The male and the young one were shot by the King on his estates. The race was a few years ago in danger of extinction, but, thanks to the King's active efforts to preserve it, its numbers have now increased to many hundreds. At the presentation, which was made by King Alfonso on July 7, King George was also present, and their Majesties were received by four of the Trustees—the Archbishop of Canterbury, the Earl of Crawford and Balcarres, Lord Rothschild, and Mr. F. Cavendish Bentinck—and by Sir Frederick Kenyon, Dr. W. T. Calman, Major E. E. Austen, Dr. W. D. Lang, Dr. G. T. Prior, Dr. A. B Rendle, and Dr. G. F. Herbert Smith. The Spanish Ambassador and the Duke of Miranda were also present.

ELSEWHERE in this issue a communication from Mr. L. S. B. Leaky deals with the discoveries relating to early man in Kenya Colony, to which reference was made in Nature of Jan. 8 last. Mr. Leaky's more detailed account fully confirms the importance of this discovery, although for the moment, pending a detailed examination of the implements, pottery, and skeletal remains, and a closer acquaintance with the conditions of the finds, judgment as to its full significance must remain in suspense. It is obvious, however, that this fresh evidence of early man in East Africa presents some very striking features. Particularly interesting is the addition to the sites outside Europe upon which

a microlithic industry has been found, especially if Mr. Leaky's contention that it is mesolithic can be sustained. Features of the skeletal remains with which this industry is associated mark it off most emphatically as the culture of a race quite distinct from any of the present or of the known recent inhabitants of the country Reference to the illustrations will confirm the distinctive character of certain features which Mr Leaky describes, especially the remarkable character of the Nakuru mandible with its high ascending ramus and the long and narrow non-negroid nose of the Elmenteita people. We regret that in our previous note, as pointed out by Mr. Leaky, it was inadvertently stated that his previous archæological investigations had been carried out in Uganda instead of Kenya, and that it was not made clear that his present expedition had no relation to the previous expedition of which he was a member.

FIFTY years ago a significant event occurred in the history of the human race, whether regarded from the biological or the sociological point of view-the trial of Charles Bradlaugh and Mrs Annie Besant for republishing Dr. Charles Knowlton's pamphlet "Fruits of Philosophy," in which principles and methods of what are now called birth-control were described. From that trial sprang the neo-Malthusian or birthcontrol movement; the Malthusian League having been formed on July 26, 1877, followed by leagues in Holland, Germany, France, and several other European countries, and culminating in the American movement pioneered by Dr. W. J. Robinson and Mrs. Margaret Sanger. The interest evoked by the trial was so great that hundreds of thousands of copies and translations of the Knowlton pamphlet, of Dr. George Drysdale's "Elements of Social Science," and other booklets were sold within the next few years, and the birth-rate of England and several other countries, which had been rising before the trial, showed a more or less strong downward tendency from that year. Man had already begun to apply science to master most of the external forces of Nature, but he was still subject to the law of the struggle for existence due to excessive reproduction; and the year 1877 opened up a new era of man's control over his own destiny by the substitution of rational for natural selection. The Malthusian League will celebrate the jubilee of the Knowlton trial and of its own formation by a dinner at the Holborn Restaurant on July 26, at which Prof. J. M. Keynes will preside, and the speakers will be Dr. Annie Besant, Mr. H. G. Wells, Dr. C. V. Drysdale, and Mr. J. Sumner. Particulars can be obtained from the Secretary of the League, 120 Victoria Street, S.W.1.

There were at one time few British men of science more widely known than Sir Frederick Abel, the famous chemist, the centenary of whose birth falls on July 17 of this year. All his life Abel was associated with notable men and institutions. One of the twenty-six original students of the Royal College of Chemistry, he was made one of Hofmann's assistants and became the successor of Faraday at the Royal

Military Academy, Woolwich. This appointment determined his career and most of his original work related to explosives. He collaborated with Dewar and with Noble, and with Dewar was the inventor of cordite. His standing was such that at various times he was president of the Chemical Society, of the Institution of Electrical Engineers, of the Iron and Steel Institute, and of the British Association. Neither did his public services end here, for on his retirement as Chemist to the War Office he was made chairman of the General Committee on Explosives, and for several years was Secretary and Director of the Imperial Institute. He took a leading part in promoting the testimonial to Hofmann in 1888 and delivered one of the Hofmann Memorial Lectures to the Chemical Society. Abel died on Sept. 6, 1902.

An interesting development in the financing of mdustrial research has recently taken place in Australia. For many years tobacco has been grown in various districts, but for the most part the colour and aroma have been unsatisfactory, comparing most unfavourably with Virginian leaf A leading tobacco manufacturing company in the Commonwealth, The British-Australasian Tobacco Co, Pty. Ltd., has incorporated as much of the local leaf in its products as its customers will accept, and has made considerable effort. without much success, to discover the reasons for its inferiority. It has now offered to provide £20,000 towards the cost of a thorough scientific investigation of the whole problem of tobacco-growing, on condition that the Commonwealth and State Governments provide £10,000. If, when this sum is exhausted, the results obtained appear to justify it, the Company will give an additional £30,000 if the Governments will give a like sum. Thus altogether £90,000 will be available for the investigation.

THE Commonwealth Government has accepted this generous offer, and the executive control of the work is to be handed to a committee of three members. Mr. H. W. Gepp (chairman of the Development and Migration Commission), Dr. A. C. D. Rivett (chief executive officer of the Council for Scientific and Industrial Research), and a third member to be nominated by them, who will probably be Dr. Darnell Smith of the N S.W. Department of Agriculture. Dr. Smith has recently completed some very successful work on the control of blue mould in tobacco plants. The services of experts in tobacco growing both in the Commonwealth and abroad will be sought, but it is expected that many years of work will be required before the problem of growing first-class Australian leaf is solved. This is one of the first instances of a business organisation placing large funds for the investigation of a national problem in which it is interested at the disposal of government institutions. and it is to be noted that the Company has deliberately refrained from seeking any measure of control of the work or of the expenditure upon it.

Several interesting photographs of the eclipse of the sun on June 29, including the picture reproduced in Nature of July 9, were shown at the meeting of the British Astronomical Association on July 6. Among the lantern shdes exhibited were some striking photographs of the corona taken at Giggleswick by Dr. R. L. Waterfield. One of these is here reproduced (Fig. 1) with the disc entarged to double its diameter on the original negative. This picture was obtained with a Wray visual lens of 4-in, aperture and 60-in, focal length. A super-speed panchromatic plate (reputed speed, 1250), kindly prepared and provided by the Imperial Dry Plate Co., was used, and the exposure was just under one second. Five

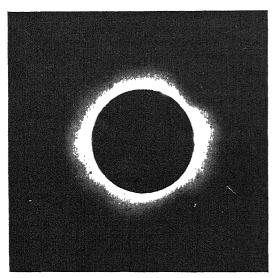


FIG 1 —Photograph of solar corona, taken at Giggleswick on June 20 by Dr. R. L. Waterfield  $\times 2$ . Exposure 1 sec

inches in front of the plate a Beta (Ilford) filter was placed, and this, by cutting out both the blue and red ends of the spectrum, corrected the visual lens and avoided sky scattering. The exposure factor of the filter was 3; hence the effective focal ratio was increased from f 15 to f 45. A large part of the extent, and much of the fine detail, has, of course, been lost in the process of reproduction, so that the accompanying illustration does not do justice to Dr. Waterfield's beautiful picture. We understand, however, that lantern slides are being prepared by Messrs. Hamblin, Ltd., 15 Wigmore Street, London, W.1, and will shortly be on sale.

COMMANDER R. E. BYRD, who recently flew the Atlantic and last year flew from Spitsbergen to the Pole and back, proposes to lead an expedition to the Antarctic leaving America in the autumn According to the Times his base of operations will be on the edge of the Ross Barrier and the purpose of the expedition will be scientific exploration of Antarctica. The expedition will number about fifty men and will take two aeroplanes in addition to dogs and sledges. The aeroplanes are to be provided with floats interchangeable with skis. One of the machines will be three engined and used for a flight to the Pole. The other smaller machine, with one engine, is to be employed in reconnaissance work. Commander Byrd

is reported to have expressed his belief in the existence of a large area in the continent not covered by snow. Enough is known of Antarctica to make it possible to deny the probability of this. At the same time, if landing-places prove suitable, some useful general work might be done by aeroplane, particularly to the south and east of Edward Land. In the autumn a projected Argentine expedition has already announced its plans of flying from Graham Land to Victoria Land.

The terrible floods which have recently occurred in the Lower Mississippi Valley have been taken as the text for an article issued by Science Service of Washington on the ancient issue of forests versus engineering works as means of preventing floods. America lacks any results based on actual scientific experimental work in this direction. But it is pointed out that the older countries of the world have spent long years (the word might have been centuries) in the hard school of adversity and in acquiring experience in this matter and have learnt many lessons France, Italy, Switzerland, and Spain have suffered severely in the past through the disafforestation in mountainous regions of the catchment areas of the big rivers Large sums of money have been spent in Europe and much patient experimental work has been carried out to build up the knowledge and scientific data which are available at the present day. In dealing briefly with this matter, the writer points out that floods are not only detrunental, through the sheer weight and force of the water, to property, both house and land, as also a danger to life; but he shows that they carry along with them in their destructive path great quantities of the earth's most fertile soil, which fills up reservoirs and irrigation works, silts up rivers and streams, chokes harbours and forms bars across the mouths of previously navigable rivers. He instances America's danger owing to the unchecked lumbering of the forests which has for so long taken place; and concludes his note with the statement that expert opinion nowadays is unammous in making use of a combination of engineering methods and forestry to control floods, rightly saying that both foresters and engineers in Europe hold that the establishment of a forest cover is a very necessary step.

The new giant dirigible R100, which is being built at North Howden, Yorkshire, will have accommodation for a hundred passengers and a crew of lifty. The electrical equipment is being provided by the Metropolitan Vickers Electrical Company and presents novel features, as considerations of safety and the necessity of using the lightest possible material complicate the problem. It is necessary to use equipment of the least possible size and the highest efficiency. Two generators giving a total output of 25 kilowatts are to be installed in the machinery cars, where they will be driven by the small petrol engines used for starting the main driving engines of the airship. The casings and fittings throughout the ship will be made of light alloys. A cable having its conductor

and sheathing both of aluminium will be used. As the envelope has a capacity of five million cubic feet of gas, every precaution has to be taken to prevent open-air sparking due to any fault in the wiring. The sheathing of the cable, although it is strong, is capable of considerable extension. In the event of undue forces being applied to it, the conductor will break whilst the sheath is still intact, and thus an external spark will be prevented. The electrical system provides for compartment and navigation lighting, compartment heating, cooking, water heating, and radio signalling.

Radio beam communication has been making most satisfactory progress in Great Britain, mainly due to the ability of the engineers of the Marconi Company The beam systems connecting the Post Office directly with Canada and Australia are working well. The system connecting London and Cape Town is finished, and the last of the Imperial group of the radio beam stations connecting London and India will be inaugurated next month. In the original contract it was specified that communication with Cape Town should be maintained for at least eleven hours a day. Senatore Marconi found in 1924 that when the wavelengths transmitted were less than 100 metres. excellent communication could be maintained during the night time. He also found out that when the wave-length was lowered below 30 metres, daylight signals could be sent but night signals deteriorated. Further investigation showed that to Cape Town, wave-lengths of 33 metres were excellent during darkness and waves of 16 metres were equally excellent during daylight. By using two wave-lengths, therefore, they are able to maintain almost continuous service. The Marconi Company calculates that good traffic operation, high-speed duplex operation at speeds of more than 100 words per minute, can be maintained for about 22 hours per day outwards to Cape Town and about 20 hours a day inwards from South Africa. These results are as welcome as they are unexpected. This is the first station to use two wave-lengths, one for daylight and the other for night communication. It is particularly convenient that the standard time of the Union of South Africa is only two hours fast of Greenwich time. Sunset and sunrise therefore in both countries occur at nearly the same time. In the case of the Australian service, only one wave-length is used, but transmission takes place in one direction round the world during one portion of the 24 hours and in the opposite direction during the remainder of the time.

THE Institute of Physics gives notice that its examination of candidates for associateship will take place in London in September next. The latest date of entry for the examination is July 31. Forms of application can be obtained from the secretary, 1 Lowther Gardens, S.W.7.

RESEARCH Fellowships for work on textiles or any problem having a bearing on wool, in chemistry, engineering, physics, zoology, or other sciences, and Advanced Scholarships for those intending to enter the

woollen and worsted industries, are being offered by the British Research Association for the Woollen and Worsted Industries, particulars of which are obtainable from the Secretary, Torridon, Headingley, Leeds. The latest date for the receipt of applications is July 31.

The following have been elected honorary fellows of the Royal Society of Edinburgh: British Honorary Fellows—Sir William Bragg, Sir David Bruce, Sir J. B Farmer, Sii F G Hopkins. Foreign Honorary Fellows—Niels Bohr, professor of physics, University of Copenhagen; Jules Bordet, professor of bacteriology, University of Brussels; Albert Einstein, professor of mathematical physics, University of Berlin, Hans Horst Meyer, emeritus professor of pharmacology, University of Vienna, Johannes Schmidt, Carlsberg Laboratorium, Copenhagen, Richard Willstatter, professor of chemistry, University of Munich

A service of air liners for passengers and mails is being rapidly developed in America. Science Service of Washington gives details of several of the longer routes. A service between San Francisco and Chicago is now open and will be extended to New York in August. The transcontinental journey is timed to take 32 hours compared with about four days by rail. Other routes now working are between Boston and New York, Salt Lake City and Los Angeles, and Seattle and Los Angeles. The long-distance routes are now lighted for night traffic. On Aug. 1 the air mail routes will pass from government to private control, and most of the lines which now carry only mails will then cater for passengers also.

THE preliminary programme has been received of the fifth International Congress of Genetics, to be held in Berlin on Sept. 11-18. The presiding committee includes leading geneticists from various countries interested, and general addresses have already been arranged to be given by such wellknown workers as Wettstein, Rosenberg, Pearl, Federley, Vavilov, Pézard, Correns, Seiler, Crew, and Muller. English, French, and German are proposed as the official languages, and other languages may be admitted by action of the Congress. The membership fee is 15 Reichsmark, while the subscription price for a copy of the Proceedings of the Congress is fixed at 30 Reichsmark. Ladies accompanying members to the Congress pay no additional fee. Those intending to read papers before the Congress are asked to notify the Committee before Aug. 1. The Congress is divided into three sections: (1) General genetics and cytology. (2) Heredity in man and eugenics. (3) Animal and plant breeding. In addition to papers and demonstrations, excursions during and after the meetings are being arranged. Requests for further information should be addressed to Prof. Erwin Baur, Albrecht-Thaer-Weg 6, Berlin-Dahlem.

AT the recent meeting of the Trustees of the Beit Memorial Fellowships for Medical Research, Dr. H. H. Dale, head of the Department of Biochemistry and Pharmacology of the Medical Research Council, was appointed a member of the advisory board in succession to the late Prof. E H. Starling. The following elections to fellowships were made, the subject of research and value and term of the tellowship being indicated after the name - Senior Fellowship in Tropical Medicine (£1000 a year for five years). Dr. E Hindle—spirochætosis, with special reference to the causation of yellow fever. Junior Fellowship in Tropical Medicine: Dr H. P. Hacker-problems in the prevention of malaria Junior Fellowships (£400 a year): Dr. F. R Winton—the physiology and pharmacology of urmary secretion and the physiology of manunahan plain muscle, Mr. W. R. Wooldridge-bacterial chemistry and its application to immunological problems, Mr W T J. Morgan—the structure of the hexosephosphoric acids by the method of methylation and subsequent oxidation; Mr. P. Eggleton-the carbohydrate metabolism of contractile tissue and a comparative study of different types of contractile tissue; Mr G. F Marrian—the physiological rôle of vitamin B, and the chemistry and physiology of the adrenal glands; Mr. A. R. Fee—the oxygen usage of the kidney, with particular reference to the action of pituitrin, and the factors controlling the elimination of acids and alkalis by the kidney, by the isolated heart-lung-kidney preparation and other methods. Three appointments of Junior Fellows to Fourth-Year Fellowships and one appointment of a Fourth-Year Fellow to a Senior Fellowship were also made

APPLICATIONS are invited for the following appointments, on or before the dates mentioned .—A master for mechanical engineering subjects and mathematics at the Sheerness Technical Institute and Junior Technical School—The Puncipal, Technical Institute,

Assistant chemistry and en-Sheerness (July 18) gineering drawing and mathematics masters at the Junior Technical School, Smethwick—The Director of Education, 215 High Street, Smethwick (July 23). An assistant to the director of the Chineal Laboratory of the Manchester Royal Infirmary, with research experience in physical or organic chemistry or in biochemistry—The General Superintendent and Secretary, Royal Infirmary, Manchester (July 28). A principal of the Mansfield Technical College-The Director of Education, Shire Hall, Nottingham (July 30). Two research fellows in the Department of Glass Technology, The University, Sheffield—The Registrar, The University, Sheffield (Aug. 6). A student probationer (Aug. 13) and a technical laboratory assistant at the Millport Marine Station of the Scottish Marine Biological Association—The Secretary, Scottish Marine Biological Association, 88 Bath Street, Glasgow. A professor of chemistry in the University of Melbourne — The Agent - General for Victoria, Australia, Victoria House, Melbourne Place, Strand, W.C.2 (Oct. 1). A lecturer in mathematics at the Gordon College, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1. An assistant lecturer in science at the Training College, Carmarthen-The Principal. An engineering workshop instructor at the Battersea Polytechnic-The Principal, Battersea Polytechnic, Battersea, S.W.11. A demonstrator of pathology in the University of Bristol-The Registrar. Two entomologists in the agricultural department of Kenya and two entomologists in the agricultural department of the Straits Settlements and the Federated Malay States - The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1.

# Our Astronomical Column.

The Nautical Almanac for 1929 —A number of changes and additions in this issue of the "Nautical Almanac" call for comment. At the meeting of the International Astronomical Union at Cambridge in 1925, a resolution was adopted to the effect that the ephemerides should give 5-figure values of the logarithms of the quantities  $\rho \sin \phi'$  and  $\rho \cos \phi'$ , including the effect of altitude, for each observatory. This has already been done, and natural values as well as logarithms are given. The number of observatories listed has been more than doubled, while the list has been divided into two—active observatories and former observatories. A third or index list gives every conceivable cross-reference. The lists appear to be very complete, and it is stated that in each case the authority for the latitude and longitude is a reply sent by the observatory to a circular letter.

The list of Standard Times has been greatly extended, and Non-Standard Times added, so that two pages summarise the times adopted in every civilised country.

There is an addition which should be welcome to those who compute orbits of comets and asteroids. This is the sun's co-ordinates, both spherical and rectangular, for the equinox of 1950-0, for each midnight in 1928 and 1929. The longitude and latitude are given both to 0°-00001 and to 0"-1, and the natural radius vector (an invitation to calculating machines) to seven decimals; first differences are

printed throughout. The co-ordinates X,Y,Z are given to seven decimals as usual, but with first and second differences.

Two pages are devoted to interpolation tables, in the critical form, giving coefficients of the second, third, and fourth differences. It is believed that this is the first occasion on which the principle of critical tables has been applied to published interpolation tables. They can be recommended not only to astronomers, but also to all who have to deal with the art of interpolation.

The other features remain as in 1928. It is stated on page 667 that considerable changes are contemplated in the "Almanac" for 1931. The "Almanac" is available either in paper covers as formerly, or bound in cloth.

THE STONYHURST COLLEGE OBSERVATORY.—The Report of this observatory for 1926 is to hand. The solar disc was drawn on 281 days; the mean daily disc area of spots, in units of 1/5000 of the visible surface, was 5 33, as compared with 3 53 in 1925 and 1·36 in 1924. The activity was equally divided between the northern and southern hemispheres. The magnetic activity increased in sympathy with the spot activity. There were 31 per cont. 'quiet days' as compared with 36 in 1925. 32 earthquakes were recorded in 1926, 55 in 1925, and 106 in 1924.

# Research Items.

THE LAPCHAS.-Vol. 31, No. 4, of the Journal and Proceedings of the Asiatic Society of Bengal is a study of the folklore of the Lapchas of Sikhim, supplemented by incidental notes on their social anthropology, by Mrs. C. de Beauvoir Stocks, which is based upon observations made on two journeys in that country m 1925. Very little attention has been paid to the Lapchas and, owing to contact with Tibet—the Lapchas and, owing to contact with Tibet—the Sikhim Rajas are of Tibetan descent and are recognised as in a sense alien by the people-and India, and their conversion to Buddhism, their folklore shows extraneous influences, also perceptible in their customs and beliefs, but not always easy to disentangle in the present stage of our knowledge of them and their immediate neighbours among the Himalayan peoples. For example, the conceptions of gods is vague, and apparently it had not attained any advanced stage of development when it was superseded by Buddhism. It would appear that there were five derities, but even their names may have been forgotten as the terms at present applied to them m certain cases are purely descriptive, e.g. It-Mo, "The Ancient Mother," while others are of Tibetan origin. The five original deities are a family of mother, father, two children, and a son of the mother. Among them the creative power is attributed to the female deities. The mother is probably the living force of the animal and vegetable world. An especially significant figure is the Bong-thing, or medicine man, the son of a goddess who was sent as a Shaman to relieve human beings from the tortures of the demons. In Lapcha belief, as in Tibetan Buddhism, and in India, demons play a very prominent part, and the heroical tales are filled with demoniacal beings, ogres, etc., who haunt every locality which presents some dangerous or unusual character, such as the unhealthy jungle with its dangers from wild animals, or a hill-top, or cascade. One demon inhabiting the top of Mt. Tendong was said to take a toll of two lives in each year.

EGYPT OVER THE BORDER—Sir Flinders Petrie in Part II. of Ancient History for 1927 describes the results of his excavations in Palestine during the past winter. The site chosen for excavation was Tell Jemmeh, which has been conjectured to be the site of Gerar. It has fifty feet depth of runs, all dating from before the Roman period, whereas the "ruins of Umm Jerar," formerly identified with Gerar, are entirely of late Roman Age. The site is evidently, from the size of the ruined granaries, of importance as the centre of a great corn country. This fact, in conjunction with its position, explains much of the Genesis narrative. Four periods of construction so far have been examined: (1) The granaries, which belong to the latest occupation of the site in the fifth and fourth centuries B.C. These must have served as the base of the Persian army in maintaining the Persian hold on Egypt, for they are much larger than the needs of the inhabitants would require, being twenty and thirty feet across and probably thirty and fifty feet high. (11.) A fort similar to those of Naukratis with pottery of the seventh century B.C.; foundation deposits of model corn-rubber and calf bones marking it as of Egyptian origin. Scythian bronze and arrowheads were found around it as well as an iron arrowhead of the type found later in central Russia. (iii.) Chambers built without any regular plan with Cypriote pottery of the eighth and ninth centuries B.C. (iv.) Buildings of grand style built of great yellow bricks in a thoroughly Eygptian method of construction, which at latest can be assigned to the time of Shishak. Thirty feet of ruins still remain to be uncovered.

SPRAYING POTATOES.—Potato blight is a disease which attacks the haulms and foliage of the plant, and also causes the tubers to rot. In general it may be expected in Great Britain between mid-May and mid-June, though the time of its appearance varies in different parts of the country, usually being later in the north and drier eastern counties, for it is greatly encouraged by wet and mild conditions. Methods for the prevention and control of this disease are given in the Ministry of Agriculture's Leaflet No. 23. Bordeaux and Burgundy spray mixtures are especially recommended, successful results having been obtained since their first employment in 1885. Both contain copper sulphate, mixed with milk of lime and washing soda respectively, and full details of their preparation are given in the leaflet. The spray forms a gelatinous film over the surface of leaf and stem, acting as a protective rather than a remedy against the fungus, therefore spraying should preferably be done before the blight is detected. A second application after an interval of three or four weeks is recommended, and in wet summers a third may be needed. Dusting with powders is also used, but the results are not so satisfactory, as a less efficient film is formed. Further, the commercial article is liable to contain impurities, whereas the ingredients of the spray mixtures are readily obtained pure. Dusts are therefore not recommended except in cases where a shortage of labour or water occurs, though they are preferable to no action at all. The cost of one spraying is probably between 5s. and 7s. 6d per acre, 100-120 gallons of mixture being required; to this must be added the cost of labour. The increased value of the crop may on an average be reckoned as equivalent to the selling price of one to two tons per acre.

GREENHOUSE FUMICATION.—A number of pamphlets have recently come to hand dealing with greenhouse furnigation by means of calcium cyanide. With the expansion of the greenhouse industry there is an increasing demand for efficient fumigants. The old method of generating hydrocyanic acid gas by means of sodium cyanide or potassium cyanide and diluted sulphuric acid involves both trouble and some skill. Within the last two or three years calcium cyanide has been widely tested in the United States and placed on the market. In England this compound has also attracted some attention and a certain number of trials have been made According to Mr. H. W. Miles (Annals of Applied Biology, vol. 14, 1927, p. 240), for the majority of plants, routine fumigations require only one-quarter ounce of calcium cyanide per 1000 cubic feet of space to maintain a high degree of pest control. Its special advantages are the ease attending its use, since the powder is merely poured from its container into a measuring receptacle and distributed along the greenhouse paths, the house being then closed down and locked. On coming in contact with atmospheric moisture the calcium cyanide slowly evolves hydrocyanic acid gas. With the dosage mentioned it is stated that an area of 40,000 cubic feet can be furnigated at a cost of 1s. 8d. plus the cost of labour.

ACARINE DISEASE IN HIVE BEES.—Bulletin 33 (1927) of the North of Scotland College of Agriculture, by Dr. John Rennie, deals with the cause, nature, and control of Acarine disease in the hive bee. It is now tolerably well known that in this disease the thoracic breathing tubes of the bee are infested with mites which pass their whole existence in that situation. These mites are true parasites belonging to the family Tarsonemidæ and to the species Acarapis woodi

Rennie. Worker, drone, and queen bees are all liable to infection and, when the mites become securely established, affected bees eventually become disabled. This is primarily due to the continuous loss of blood, which the mites absorb through their piercing mouth-There is, further, a blocking of the air-tubes by the mites, which thus restricts the oxygen supply of the bee and causes a deterioration of the tissues connected with the infested parts. Weakened bees may work for a long time, but finally become unable to fly or to share in the normal life of the colony: the larvæ or brood of the bee, however, are never infested. The difficult subject of treatment of the disease is discussed at length. With slight infestations and with a stock numerically strong in autumn, there is a possibility of survival In cases of this kind where the percentage of intested bees in a random sample is about 30 per cent. or less, treatment of the hive with a mixture of chloropicrin, camphor, and methyl salicylate in minute doses is advised. This mixture, it is claimed, kills the parasitic mites without seriously interfering with the bees. Stocks badly infested in autumn or spring are useless; they merely function as sources of infection and are best destroyed. In cases of summer infection, treatment with volatile substances is not expedient, and success in such cases rather lies in management, so that the maximum of young foraging bees is produced at the time of honey flow. This is best effected by the early introduction of young queens, which produce bees faster than the disease can destroy them. Stocks thus saved, even though only temporarily, can be maintained for a time, at least, with profit.

SALMON OF THE OUTER HEBRIDES.-We have for the first time information on the salmon of the Grimersta District, Lewis, as a result of examination of scale measurements and other details obtained by Mr. W. J. M. Menzies (Fisheries, Scotland, Salmon Fish., 1926, 6 (January 1927)). A total of 803 fish taken on rod and line in 1925 are dealt with. Of these fish, 80 per cent. were grilse, the remainder being mostly 2 and 2+ winters fish. Compared with east-coast districts the scarcity of small summer fish was marked. The grilse were mostly taken in July, August, and September, 57.3 per cent. of the whole season's catch of grilse occurring in July. Previously spawned fish were only slightly more numerous than in the steadily netted districts of the east coast. average smolt age was considerably higher than in most other east-coast districts, 60 per cent. migrating in their third year; this is perhaps to be correlated with the scanty food supply available in the waters, which are surrounded by infertile, peaty and rocky country. One-year smolts were entirely absent, and 5 per cent. of the parr stayed in the fresh water for four or even five years before migrating The grilse four or even five years before migrating were a pound heavier and nearly two inches longer, on the average, than those from the Dee and Spey, but it is to be remembered that in the Grimersta district they run later than they do on the east coast, which possibly gives more time for feeding and growing. The scale erosion on the grilse begins in July, that is, very soon after cessation of feeding, the percentages with eroded, or, rather, absorbed, scales being 49.2 per cent. in July, 99 1 per cent. in August, and 100 per cent. in September. A check in growth was also noticed on the grilse scales, occurring apparently at about the same time as is the case for east-coast fish.

NATURAL PLANT HYBRIDS.—Numerous natural hybrids have been recognised in the flora of New Zealand, and Mr. H. H. Allan has recently described several of these hybrid swarms in a series of short

papers in Genetica (vols. 7 and 8). Some of the hybrid forms have been produced artificially by crossing. Coprosma Cunninghamii, which was described by Sir Joseph Hooker as an extremely variable species, is found to occur wherever C. robusta and C. propingua grow together. An artificial cross of these species produced a uniform F<sub>1</sub> closely resembling some forms of the wild C Cunninghamir. Melicope simplex  $\times M$ . ternata gives a series of wild forms which are believed to be partly the result of epharmonic response by the individual to wind-swept conditions and partly the sorting out of suitable forms by the diverse conditions. Other apparent wild hybrid swarms are Nothopanax anomalum  $\times$  N. simplex, Hoheria augustifolia  $\times$  H. sexitylosa and Corokia buddleoides  $\times$  C. Cotonicuster. A hybrid community of Hebe (the shrubby Veronicas) is more fully studied in conjunction with Messrs. G. Simpson and J. S. Thomson. The Hebes at Blanket Bay are found to show a mingling in various degrees of the characters of H elliptica and H, salicifolia var. communis, which are also found in the community. The conditions indicate a freely intercrossing population of forms in areas where both species occur; and the same is believed to apply to various other pairs of species of Hebe as well as other genera results will be further elucidated by crossing experiments which are being undertaken

CURRENTS OF THE ENGLISH CHANNEL.—Mr. J. N Carruthers (Jour. Marine Biol. Assoc, vol. 14, No. 3, March 1927, pp. 685-721) reports on an experiment with drift bottles, both surface and bottom, carried out by the Ministry of Agriculture and Fisheries and the Marine Biological Association jointly in July 1924. The bottles were liberated at the International Stations E2 and E3, and on the steamship route Southampton-St. Malo Of the surface bottles, those which did not run ashore on the Channel coasts were carried rapidly up Channel into the North Sea and across to the Dutch and Scandmavian shores. Many reached the Skaggerak, some 700 miles away, travel-Img at an average rate of 6 miles a day or more. During the period covered by the experiment there was an almost unbroken prevalence of south-westerly It cannot of course be inferred from these results that the water mass as a whole moved with the velocity indicated, and further experiments with wellsubmerged drifters would be valuable and interesting. The results have, however, enabled Mr. Carruthers to work out a relation between velocity of wind and surface current which corresponds closely with that found by R. Witting in the Baltic. The information yielded by the bottom bottles is summed up by Mr. Carruthers as follows: "There seems to be in Long. 2° W. (approximately) a parting of the ways in respect of the movements of the bottom water. To the north of 50° N. Lat. there appears to be a west-going bottom set, whereas to the south of this parallel there is a set in an easterly direction.'

Speed of Light in Moving Bodies —In the tenth volume of the Archives Néerlandaises des Sciences Exactes, Prof. P. Zeeman has collected together the work done by himself and his colleagues to determine the fraction of the speed of a moving body through which light is passing, which must be added to the normal speed of light to give the actual speed of the light. According to Fresnel, this fraction should be  $1-1/\mu^2$ , where  $\mu$  is the refractive index of the material for the light used. According to Lorentz, this fraction should be increased by  $(-\lambda/\mu)d\mu/d\lambda$  where  $\lambda$  is the wave-length. The measurements were made on water flowing through pipes and on quartz and flint-glass rods to which a to-and-fro motion was given by means of a revolving crank and connecting rod. The method

used was in principle that of the Michelson interferometer. The results agree with the formula of Lorentz

THE POSITIVE COLUMN OF GEISSLER DISCHARGES -Prof Guntherschulze has recently published the results of an extended series of measurements made by him on the electric fields present in a uniform positive column The point on which he lays particular stress is that the mean free path, rather than the pressure, is the relevant variable, and that it is therefore necessary to take into account the temperature of the ionised gas, which can be calculated in the way proposed many years ago by Warburg. With this precaution, the results of his measurements are fairly well expressed by two semi-empirical formula. For polyatomic gases the potential gradient is determined by the mean free path and by the diameter of the tube, and is practically independent of the current density for monatomic gases the gradient is independent of the mean free path (and hence of the pressure), but is a function of both the current and the size of the tube The processes of ionisation and conduction in a discharge-tube are still imperfectly understood, in spite of much recent work on the subject, but the data in these papers (Zeitschrift fur Physik, 41, p. 718, and 42, p. 763) provide valuable material for future theoretical development.

THE X-RAY INVESTIGATION OF INDIA-RUBBER.-In the *Chemiker-Zeitung* for May 21 is an account of two lectures by Dr J. R. Katz of Amsterdam on the application of X-ray analysis to the structure of india-rubber. So far, rubber in the unstretched condition has yielded very little information beyond the production of an 'amorphous ring spectrum,' similar to that obtained from liquids Recent work by the author appears to substantiate the hypothesis put forward by him in 1925 that rubber changes on stretching from an amorphous to a crystalline condition, the degree of change depending upon the extension. X-ray examination has revealed indications of a three-dimensional orientation of molecules, undiscernible in the unstretched material, although some of it still remains amorphous, as shown by the unchanged diameter of the 'amorphous ring' of the spectrum Moreover, there is a critical extension, below which the phenomenon is not observed. The conflicting results of W. H. Keesom's attempt in 1922 to apply a modification of Bragg's formula—which was specially designed for crystals-to calculate the mean distance of adjacent molecules (to a first approximation) in a liquid from the diameters of these rings, have now been shown to be due to the fact that the molecules were always assumed to be approximately spherical. This assumption is of This assumption is of course only applicable in certain cases, and it is now shown that the abnormal values were due to marked deviations in molecular structure from the spherical shape. The experiments of Katz appear to open a new and promising field of research.

HELIUM IN CANADA.—A comparatively new use of helium, and one that promises to become of very great importance, is its utilisation in the production of artificial atmospheres under which divers and caisson workers carry out their operations. It is anticipated that such atmospheres will permit of much greater depths being reached under water, longer periods being spent without fatigue, and, in the case of tunnel and caisson workers, that the prevention of what is known as 'caisson disease' will be facilitated. Investigations along these lines are being carried out by the United States Bureau of Mines, and accordingly considerable impetus has been given to the helium industry, which thus has other outlets besides that

of supplying airships with non-inflammable gas Canadian Mines Branch, during the period 1922 to 1926, made a special study of the helium-content of natural gas occurring within the Dominion, and the results of this investigation are now available in a report under the above title by Dr. R. T. Elworthy (No 679 Ottawa F A Acland 20 cents) significant that Canada is the only source of helium in the British Empire The report summarises our knowledge of this gas and is particularly valuable for its account of modern methods of recovery, it includes details of the varied helium-bearing gases (with analyses) in the Dominion and much interesting experimental data The most important source of supply of this substance discovered is in the natural gas from three small wells at Inglewood, Ontano, which yields as high a percentage of helium as that forming the basis of commercial operations at the well-known plant at Fort Worth, Texas; leases have been taken up by the Ontario Government in the Inglewood district, and it is anticipated that the National Research Council will lay down an experimental helium extraction plant, providing sufficient gas is available. The natural gas of Alberta, with the exception of Bow Island and Foremost fields, contains little or no helium, which, in view of these enormous resources, is unfortunate. However, if only 0 2 per cent. helium-bearing gas could be treated economically, it is believed that the Dominion could supply about 5,000,000 cubic feet annually.

Iron and Steel in India.—A paper by Richard Mather published in the Journal of the Royal Society of Arts, May 13, reveals the rapid advances which have been made during the last twenty years or so in the ferrous industries of India. Although Indian Wootz steel has deservedly possessed the highest reputation for quality for hundreds of years, it has only been during the last decade or two that the mitial difficulties associated with the establishment of a heavy iron and steel trade there have been overcome. Now, however, a large portion of the existing Indian demand is satisfied by Indian products, and also a surplus is available for export. This applies to pig-iron rather than steel, and the growth in the exports of this material during the last few years are as follows:

Year		7	Cons of pig-tron exported
1923			181,500
1924			271,000
1925			402,000
1926			315,000

In 1926, Japan took 75 per cent. of this iron and the United States 13 per cent In the former country Indian iron has become a serious competitor with the home product. With regard to steel, Indian production in 1911 was 10,000 tons, last year it was 540,000 tons, and it will probably exceed 600,000 tons in the present one. So far as future developments are concerned, Mr. Mather states that "the conclusion may safely be drawn that the Indian steel industry will develop, perhaps fairly rapidly, during the next few years, and that for some time afterwards its growth will depend mainly on the rate at which the demand increases. But for the next few years imports will not diminish to a great extent, unless the consumption declines or remains stationary; and even in later years there will remain an important market in India for certain kinds of steel " As an example of the value of this industry during the War, it was pointed out in the discussion that the military railways by which the Mesopotamian campaign was carried on, and even the line by which Lord Allenby made his successful attack on Palestine, were constructed of steel from the Tata works.

# National Physical Laboratory, Teddington.

INSPECTION BY THE GENERAL BOARD.

ON Friday, June 24, the General Board of the National Physical Laboratory made its annual inspection of the laboratory. A large number of visitors representative of scientific and technical institutions, Government departments, and industrial organisations were present and were received by Sir Ernest Rutherford, president of the Royal Society and chairman of the General Board of the Laboratory, Sir Richard Glazebrook, chairman of the Executive Committee, and Sir Joseph Petavel.

The varied nature of the work of the laboratory was well illustrated by a large number of interesting

On the new whirling arm in the Aeronautics Department. measurements were being made of the rolling moments at a steady rate of turning of a model Bristol Fighter aeroplane With the whirling arm stationary a definite moment about the axis of flight can be impressed on the model by magazing. flight can be impressed on the model by means of a spiral spring situated inside it. The resulting displacement effects a separation of the primary and secondary coils of one of two similar electromagnets, the other of which is mounted in the control room Their primaries are connected in series while their secondary voltages are opposed, so that the displacement produces an out-of-balance current which is indicated by a galvanometer. The speed of the whirling arm can then be adjusted until the galvanometer deflexion is zero, when the air moment at that speed is equal to the impressed moment.

In one of the wind tunnels an investigation of the conditions under which wing flutter may occur was in progress. Points on a selected chord of the wing section are connected by light spring-controlled wires to pivoted levers carrying small mirrors and by suitable optical arrangements their vibrations are recorded on sensitised paper. Permanent magnified records are thus obtained and the vibrations of the wind under various conditions can be directly

compared.

The Engineering Department exhibited apparatus for the electrical integration of wind pressure. The apparatus consists of a number of capsule diaphragms arranged in groups, each of the latter being connected to a Pitot tube The expansion of any group is magnified by a lever the free end of which carries a brush sliding over a potentiometer wire. For each group a determination is made of the potential difference between the brush and one end of the wire, and by previous calibration the corresponding wind pressure can be derived. The experimental arrangements are such that if a number of units are attached to a structure, the sum of their potential differences is proportional to the mean wind pressure on the Of interest also was a motor trailer structure. equipped for experimental work in connexion with the wear of road surfaces. An adjustable rear axle permits wheels of varying size from 18 inches to 40 inches diameter to be fitted. Motion of the rear springs is transmitted to recording apparatus in the cab by means of a prvoted lever and bowden wire.
To the coupling is fitted a traction dynamometer, the motion of which is transmitted to the recording apparatus by oil impulses on a plunger in the cab. Determinations are made of the tractive resistance and spring deflexions of the trailer, and of the horizontal and vertical movements of the road surface when the trailer is made to negotiate obstacles of various sizes.

The Metallurgy Department showed apparatus developed for the preparation of beryllium of high purity with the view of eliminating it possible the lack of ductility hitherto associated with this metal Iodine and beryllium produced otherwise are introduced by a side tube into a glass vessel in which is sealed a tungsten wire which can be heated electrically. The apparatus is exhausted and heated in a furnace until beryllium iodide is formed. At this point the tungsten wire is heated up until a temperature is reached at which the vapour pressure of the solid beryllium is less than its partial pressure in the gaseous phase, when solid beryllium is deposited on the wire

A method was also demonstrated of determining the surface tension of molten metals by means of bubbles formed on the ends of two concentric silica tubes, the ends of which are ground in the same horizontal plane, dipping in the metal. The alundum crucible containing the metal and the two tubes are surrounded by an artight furnace through which hydrogen is passed. By means of a special reservoir and valves, bubbles of hydrogen can be blown on either tube, the pressure required being indicated by a manometer. From these pressures and the dimensions of the orifices the surface tension can be calculated.

In the Metrology Department was exhibited an ingenious method of determining the cross-section of very fine quartz fibres which, owing to diffraction effects, do not lend themselves to direct measurement by projection methods. The fibre is mounted horizontally and can be loaded at its mid-point with small milligram riders. A magnified image of the fibre is projected on to a screen, and from the length and displacement of this image under different loads its extension and the forces acting along its axis can be computed. From these data and the known value of Young's modulus for quartz, the cross-section of the fibre can be readily determined

Of interest also was a sensitive tilting level for the Two fixed accurate testing of surface plates horizontal rods, on which the level can slide, bridge the specimen, and the level is racked down until its ball feet rest on a parallel block placed on the surface and moved to successive positions. An image of the bubble thrown on a scale by a semi-silvered glass plate indicates any departure from flatness, which can be computed from the radius of curvature of the level and the size of the block to one hundred thousandth of an inch.

For work in connexion with the international temperature scale a new valve-controlled highfrequency furnace capable of melting up to two kilograms of palladium by the eddy currents generated m the metal has been installed in the Physics Department. The oscillating circuit containing the furnace is included in the anode circuit of two aircooled silica valves connected in parallel and each dissipating 8 kilowatts. The furnace can be exhausted and temperatures are measured by means of an optical pyrometer.

For gas analysis an apparatus utilising high frequency vibrations has been developed. A piezoelectric quartz crystal maintained in vibiation by an oscillatory circuit is used to generate high-frequency sound waves in the gas mixture and stationary waves are formed by means of a movable reflector. When the reflector is identified with a node, resonance occurs between the gas and the crystal, which manifests itself by a large increase in the current in the maintaining circuit after the manner described by Pierce. Measurement of the wave-length then affords a measure of the composition of the gas mixture

A demonstration was given of the determination of flame temperatures by spectrum line reversal. An image of the bead of a Pointolite lamp was focused through a flame on to the slit of a spectroscope. When sodium was introduced into the flame the sodium lines were visible either as bright or dark lines superimposed on a continuous spectrum according as the flame temperature was greater or less than that of the bead. By careful adjustment of the temperature of the latter the sodium lines could be made to disappear. The temperature of the flame was then determined by measuring that of the bead with an optical pyrometer.

In the Optics Division a photo-electric spectrophotometer of general utility was exhibited, and its use for the measurement of ultra-violet absorption was demonstrated. Two monochromators in series are utilised to effect spectroscopic purification of the light from a mercury vapour lamp. The radiation then passes into a photo-electric cell fitted with a quartz window, and the photo-electric current can be measured by either a Lindemann or a Compton

electrometer

In the Electrotechnics Department was to be seen a non-reactive high resistance for use in high voltage alternating current work involving the measurement of very small power factors. Essentially it consists of a number of vertical glass tubes through which tap water can flow, arranged in parallel, and so disposed that two of them which carry the current to be measured are encircled by the remainder. The latter

screen the inner tubes, thereby reducing their capacity to earth and the consequent phase error in the current.

The Electrical Standards Division showed new apparatus for building up standard telephonic frequencies. Between the prongs of a tuning-tork controlled by a seconds pendulum is an iron-core-l bobbin which is included in the anode circuit of a multivibrator of the same frequency as the tork. By means of a selector circuit loosely coupled to the multivibrator, successive harmonics of the impulse

can be picked off.

In the Photometry Division experiments were in progress to determine the effect of a glaring source of light on the ability of the eye to detect brightness differences. An observer seated in a totally enclosed cabinet views a field of uniform brightness except for a circular central spot the brightness of which can be varied until it is no longer visible to the observer. Under glare conditions a circular spot of very high brightness is included in the field. The least difference of brightness detectable with and without glare can then be determined.

The Wireless Division exhibited an installation for investigating the distribution of current in a vertical cage aerial and for determining whether its variation is sinusoidal under transmitting and receiving conditions. Small ammeters are fixed at convenient intervals inside the aerial in order not to affect the capacity of the latter and are viewed from the ground by means of a telescope.

At intervals during the inspection, demonstrations were given in the William Froude Tank to indicate the manner in which measurements are made of the characteristics and behaviour of model sea-going

vessels.

# The Edinburgh Meeting of the Society of Chemical Industry.

A DISTINCT biochemical tendency was noticeable in the contributions brought before the annual meeting of the Society of Chemical Industry, held at Edimburgh on July 4-9 at the invitation of the Edimburgh and East of Scotland Section of the Society. In his interesting presidential address, entitled "Chemistry in the Progress of Medicine," Mr. F. H. Carr stressed the importance of a close co-operation between academic laboratories, research institutions, and industrial establishments in the search for new remedial agents, and of an equally effective liaison between the chemist, the physiologist, and the physician in elucidating the relation between chemical constitution and therapeutic properties. The body hormones are to be regarded as ideal specific drugs, the detailed study of which should do much to illuminate this problem.

Although many such agents are undergoing investigation at the present time, it can be claimed only in two or three instances that the hormone has been solated as a pure chemical individual. Adrenalme, the active principle of the suprarenal gland which plays an important part in regulating the blood pressure, has been synthesised both in the laboratory and the factory. Recently also, a similar advance has been made by Harington and Barger in the artificial preparation of thyroxine of the thyroid gland; 5 mgm to 10 mgm, of this perfectly definite substance may increase the metabolic rate of the human body by so much as 45 per cent, over a period of 14 days. Histamine, another fully characterised substance which has been shown to influence the circulation and respiration, is also apparently produced for functional

purposes in the body.

It is possible that such sub-tances are altered and elaborated in various ways in the body before being able to exert the physiological effects which are attributed to them. In general, although the action of a therapeutic agent is probably determined by its chemical constitution, the body mechanism plays an important part in the resultant chemical changes. It appears that the most effective chemotherapeutic agents act through the formation of a depôt from which they are automatically released as required depôt formation, mechanism of release, and activity in great dilution are indicated as the likely desiderate of chemotherapeutic compounds.

Most of the bacterial and parasitic diseases, as well as others due to defective functioning, await chemotherapeutic investigation. Chemotherapy is but one of the frontiers of scientific medicine, but it may well prove to be the most important. Certainly this will be so if, in the end, we learn how to stimulate at will the chemical processes of bodily defence, and thus to meet every eventuality, or to prepare substances comparable in activity and specificity with diphtheria antitoxin. Progress lies in the direction of biochemistry and more effective working contact between individuals in chemistry, bacteriology, physiology, and clinical medicine. We need to multiply a hundred times discoveries like those relating to the oxidation and reduction phenomena in the tissues, to the constitution of glutathione and of thyroxine. As these results become known, and with the fuller development of experimental technique. we need bold hypotheses like that of Ehrlich so as to open up new avenues of thought and work.

a discussion was held on "The Physiological and Industrial Aspects of the Chemistry of Carbohydrates." Recent work on structural relationships in the carbohydrate group was reviewed in papers contributed by Prot. W. N. Haworth and Prof. A. R. Ling. Di. C. G. Lambie, in dealing with the question of the intermediary metabolism of carbohydrates, advocated the view that dihydroxyacetone may be a possible common term in the metabolic transformations of carbohydrates, fats, and proteins; an assumed equilibrium of the form glucose  $\rightleftharpoons$  dihydroxyacetone, favoured in the forward direction by the presence of insulin, would then explain many of the observed facts of normal and pathological metabolism, including the phenomena of diabetes.

The industrial importance of carbohydrates was emphasised in a paper by Drs C J. J. Fox and L. Hall, in which certain recent developments in the cellulose industries were outlined. Despite the present enormous production of artificial silk, it is considered that the further applications of this material are almost unlimited. The rapidly growing demand for wood in industry renders imperative a considered study of forest economics and the adoption of a policy of afforestation which will maintain an adequate supply of this indispensable raw commodity. Of cellulose derivatives the acetate is practically non-inflammable and has other advantages over the nitrate, but it has not yet attained the level of quality and price which would enable it to displace the nitrate in the manufacture of films, etc. The study of the bacterial decomposition of cellulose by methane producers, hydrogen producers, denitrifiers, and thermophilic species has recently been renewed with the object of bringing such processes under productive control. A further paper, on "Some Aspects of the Manufacture of Fibrous Celluloses," was read by Dr. J. L. A. Macdonald before the Chemical Engineermg Group of the Society.

A wide field of industrial chemistry was surveyed A wide field of industrial themistry was surveyed by the Society's medallist, Col. G. P. Pollitt, in his lecture on "The Development of the Synthetic Nitrogen Industry in Great Britain." The decline in the utilisation of fixed nitrogen which immediately followed the War has been followed by a rapid recovery. In 1926 the world's consumption of ntrogen was 1,250,000 tons, the production having been approximately doubled since 1921. At the present rate of increase of population, and with no alteration in methods of farming, a food shortage is to be anticipated before the end of the present century. As a consequence of the necessity for increasing the output per unit of agricultural land, the nitrogen industry will become one of the most important manufactures, ranking with coal, steel, and ship-building. For economic reasons, synthetic nitrogen is gradually replacing Chile saltpetre and by-product ammonia; but such a replacement was rendered possible only through the development in Germany of the Haber-Bosch process. In Great Britain the technique of high-pressure operations has now been mastered, and there is no necessity for this country to continue indefinitely the importation of fixed nitrogen.

Among other important processes which there is a strong promise of developing in order to render Great Britam less dependent on imported raw materials are the production of liquid fuel by the hydrogenation of coal, of synthetic methanol from water-gas, and of acetylene and acetic acid from coke-oven gas. In the past there has been a tendency for an undue proportion of the most able men in Great Britain to neglect industry and to enter the services, the law, and other non-productive professions. Provided that

in the future our industries have, as in Germany, the first call on the brains of the country, there is every reason to anticipate that Great Britain will continue to lead in the world's industrial development.

Prof J. Read's lecture on "Natural Sources of Energy in Australia" afforded an appropriate indication of the world-wide interests of the Society of Chemical Industry, which has a strong membership in the Dominions and in the United States possesses a surprising variety of power resources, located mainly in the eastern coastal zone. The most important of these are black coal, brown coal, and water power; in addition there are relatively unimportant occurrences of natural petroleum (Papua), natural gas (Queensland), and kerosene shale (New South Wales). For the present the vast deposits of brown coal near Melbourne are to be utilised solely by direct combustion of the raw material the auspices of the State Electricity Commission of Victoria the first section of a power-house, with a present capacity of 50,000 kw., has been erected at Yallourn; it is proposed eventually to raise the capacity to 150,000 kw, and to interconnect the brown-coal power system with the Sugarloat-Rubicon and Kiewa River hydro-electric schemes. The consequent generation of cheap electric power, light, and heat should lead to a steady industrial expansion in this area. Hydro-electric power is being rapidly developed, particularly in Tasmania, more than 500,000 h p. having been located and surveyed in the island. A total amount of 75,000 h.p. is now available from the Great Lake and Shannon River schemes, and factories for the production of electrolytic zinc, carbide, etc., have been established in the vicinity of Hobart.

The Universities of Edmburgh, St. Andrews, and Aberdeen, which he within the area embraced by the local section of the Society, were officially represented at the meeting, and Dr. Kurt Meyer attended on behalf of the German Chemical Society. Prot. A. W. C. Menzies conveyed an invitation from the American Section to hold the annual meeting for 1928 in New York, and this was unanimously accepted.

# University and Educational Intelligence.

Cambridge.—J. A. Ratcliffe, Stokes student of Pembroke College and formerly research student of Sidney Sussex College, has been elected tellow of Sidney Sussex College and University domonstrator in physics. J. A. Steers, St Catharme's College, has been appointed University lecturer in geography, and E. G. Dymond, St. John's College, University demonstrator in physics

After some delay, the deeds executed by the late Mr. W. W. Rouse Ball of Trinity College, by which various sums were to be paid to the University, are being completed, and two sums of £25,000 each will be received for the foundation of professorships in mathematics and modern English law, and a further sum of £10,000, of which the income is to be available for the University Library.

MANCHESTER.—Dr. H B. Maitland has been appointed professor of bacteriology and director of the Department of Bacteriology and Preventive Medicine in succession to Prof. W. W. C. Topley. Prof. Maitland graduated in medicine and surgery in the University of Toronto in 1916 and obtained the degree of M.D. by thesis in 1922. He remained at Toronto as lecturer in bacteriology and later as associate

professor until 1924. Early in 1925 he was appointed to assist in research upon foot and mouth disease, later taking charge of the investigations, and he has since joined the staff of the Lister Institute.

Dr. A. J. Bradley has been elected to an honorary research fellowship in physics.

At the annual Commencement Exercises held at Yale University, Newhaven, U.S.A., on June 22, among those upon whom the honorary degree of Doctor of Science was conferred was Sir James Colquhoun Irvine, Principal and Vice-Chancellor of the University of St. Andrews

ANOTHER series (the sixth) of "Methods and Problems of Medical Education" has been issued by the Rockefeller Foundation. Twenty-eight institutions or special departments of institutions are dealt with in this series; it includes medical libraries and departments of anatomy, physiology, pathology, embryology, neurology, tropical medicine, physicotherapeutics, and others. An interesting article on the value of visual methods in education and methods of projection is contributed by Prof. Jacobj of Tubingen. Details of the staffs, salaries, wages, and cost of upkeep, and methods of instruction are given in most instances, together with plans and illustrations of the institutions and laboratories.

The first report of the English committee dealing with the same portion of the terms of reference as are dealt with in its first report by the Committee on Education and Industry in Scotland, namely, ". . . . particular reference to the adequacy of the arrangements for enabling young persons to enter into and retain suitable employment," was published at the end of last year (see NATURE, Jan. 8, p. 69). Necessarily, and obviously, the two committees have been closely in touch with each other. Among the recommendations common to both are: closer cooperation between juvenile employment committees and juvenile advisory committees; the appointment of qualified officers and the provision of suitable premises for choice of employment; a national advisory council for juvenile employment; the increase of information as to industrial conditions available to juveniles and parents; provision of public money for the purpose of a scheme of juvenile unemployment centres; legislation to cover the provision of working certificates. Both committees have seen quite clearly that between the ages of fourteen and sixteen years, "boys and girls are most impressionable, and irretrievable damage can be effected by enforced idleness." Yet during this very period there is a gap in public supervision, since the age of entry into unemployment insurance is sixteen years. Two remedies present themselves immediately: the raising of the school leaving age, and the lowering of the age of entry into unemployment insurance. With regard to the first, the English committee appeared overwhelmed by the evidence against raising the school leaving age, and became correspondingly vague: "the change, if made [our stalics], should be made for educational and social rather than industrial reasons' The Scottish committee is much more vigorous. "Due notice should be given by the Scottish Education Department, as soon as it may be found financially practicable, of the appointed day for the raising of the school leaving age to 15 years. . . . When, but not before, the school leaving age is raised to 15 years, the age of entry into unemployment insurance should be lowered to 15 years."

# Calendar of Discovery and Invention.

July 17, 1850.—The earliest photographs of stars were those of Castor and Vega obtained on July 17, 1850, with the refractor at Cambridge, Mass, by Whipple under the direction of W. C. Bond.

July 18, 1774.—The first experiments in Great Britain for determining the mean density of the earth were made by Maskelyne in Perthshire, who on July 18, 1774, wrote to Dr. Lind: "From the observatory on the south side of Schiehallien . . . I am now ready to begin making observations . . . whenever the weather will permit." The results of Maskelyne's observations worked out by Hutton gave the value 4.481. The

experiment cost the Royal Society £597:16s.

July 19, 1846—One of the many students of Liebig at Giessen was Frank Buckland, who, writing on July 19, 1846, gave his routine thus. "7.30-8 30, chemistry; 9-10, German with Dr. Adrian, 10-11, laboratory; 11-1, Liebig's lecture; 1-2.30, dinner. After dinner I occupy myself with chemistry in the laboratory, or German, as the case may be, till about 6 or 7. If ever there was a place to work in it is Giessen. The people never think of leaving off work till 6 or 7; whereas at Oxford the books are shut up at the latest at 2 o'clock"

July 20, 1854.—Liebig retired from Giessen in 1854. The English chemists, headed by Graham, sent him a testimonial "Commemorative of their profound and unalterable regard." Acknowledging the gift from Munich on July 20, 1854, Liebig began his letter: "The man of science generally knows of no other reward for the time he has devoted to the discovery of truth and to the investigation of the laws of Nature's powers, than the mental satisfaction which springs from the consciousness of having, to the best of his ability, contributed his part towards the advancement of human happiness and human welfare; for toils like this, attended as they are with so many difficulties and sacrifices, and with such mental effort and fatigue, cannot be priced in the market or sold -cannot be performed to order or turned into money. . . If I have laboured for the period of almost a human life in promoting the progress of chemistry . . . I gratefully acknowledge that I have received in return all that a man could justly aim at."

July 21, 1820.—It was between July 15 and July 20, 1820, that Oersted made his remarkable discovery of electro-magnetism, the results being made known to the world in a circular letter in Latin, dated July 21, 1820: "Experimenta circa effectionem conflictus electrici in acum magneticam." Oersted's discovery was the result of a long search for a connexion between electricity and magnetism.

July 21, 1914.—Working at Lick Observatory, Nicholson, on July 21, 1914, discovered photographically the ninth satellite of Jupiter, which, like the eighth satellite, revolves around the planet in an opposite direction to the other seven.

July 23, 1849.—On this day Fizeau communicated to the Paris Academy of Sciences the results of his determination of the velocity of light by measuring the time taken for light to travel between Suresnes and Montmartre, a distance of 28,334 feet.

July 23, 1847.—Among the important contributions to the early work on the new theories of the conservation of energy and the mechanical equivalent of heat was the memoir of Helmholtz, "Über die Erhaltung der Kraft," read to the Physical Society of Berlin on July 23, 1847. The paper was, however, refused admission to Poggendorf's Annalen, and among the older members of the Physical Society, Karl Jacobi was the only supporter of the views of Helmholtz.

E. C. S.

# Societies and Academies.

LONDON.

Royal Society, June 30 —C. Chree and J. M. Stagg: Recurrence phenomena in terrestrial magnetism. Making use of the daily international character figures for 1906 to 1925 issued from De Bilt, an attempt is made to enlarge our knowledge of the 27-day interval in terrestrial magnetism Assuming magnetic disturbance to be caused by some kind of electrical discharge from the sun, if sunspots were the sole or principal source of the discharge, we should expect the interval to be longer in years of high than in years of low spot latitude. No recognisable difference is, however, found. In opposition to results obtained by Dr. Deslandres, no trace is found of periods which are submultiples of 27 days On the other hand, days which follow from 4 to 6 days after a very quiet day prove to have a greater than average chance of being highly disturbed days.

S. Chapman: On certain average characteristics of world-wide magnetic disturbance The average characteristics of slight magnetic disturbance in the middle belt of the earth, between northern and southern latitudes of 50° or 60°, are similar to those of intense disturbance (magnetic storms) in the same

region.

Taylor: The distortion of crystals of aluminium under compression (Part ii.). Changes in orientation of crystal axes during compression of a disc cut from a single crystal of aluminium are in accordance with the prediction made on the assumption that the crystal slips as determined by distortion measurements. As with tensile test pieces, the crystal axes always take a position where two possible planes of slip are symmetrically disposed in relation to the stress, but the orientation is different. After the axes have taken the symmetrical position, they remain there, even when distortion is very great. Distortion during the period when the crystal axes remain in the symmetrical position is due to slipping on two symmetrically disposed planes of slip

G. I. Taylor: The distortion of crystals of aluminium under compression (Part in.). Several experiments were devised to find out whether it is possible to measure the internal stresses in a compressed disc. The relationship between shear stress and amount of shear is found for tensile and for compression specimens, when slipping is confined to one plane. The experimental results in the two cases are identical. The fact that the component of force normal to plane of slip is a pressure in one case and a tension in the other makes no measurable difference to resistance to slipping for given amount of slip. During double slipping, resistance to shear increases more rapidly for a given total amount of slipping than when all slip is confined to one plane. Resistance to shear goes on mcreasing up to the greatest amounts of distortion used.

Prof. J. C. McLennan, H. J. C. Ireton, and K. Thomson: The luminescence of solid nitrogen under cathode ray bombardment. The phosphorescence bands  $N_2$  (5230 Å.U.) and  $N_4$  (5945 Å.U.) have complex structures, the former having eight and the latter three components. The moment of mertia of the molecular system involved in the phosphorescence of solid nitrogen is  $3\times 10^{-40}$ . The group of bands  $N_1$  near 5577 Å.U. originate in a modification of nitrogen different from that involved in the production of the

bands N<sub>2</sub> and N<sub>4</sub>.

E. T. Paris: On the reflexion of sound from a porous surface. The 'acoustical admittance per unit area ' can be measured experimentally by means of

Continued from p. 66.

the 'stationary-wave' apparatus for testing soundabsorption, and when it is known, the coefficient of absorption (for the particular wave-length at which the admittance has been measured) can be calculated by a simple formula for any angle of meidence. For an 'acoustic plaster' there is a large variation of absorption with change of angle of meidence, the coefficient increasing from 0.28 at normal incidence to 0.76 at about 83° and then falling to zero at grazing incidence. Heavy absorption at very oblique meidence appears to be characteristic of plasters of this kind.

C. J. Smith. A new differential dilatometer for the determination of volume changes during solidification. The dilatometer has two bulbs immersed in a thermostat, the change of volume of the substance contained in one bulb being compared with that of a corresponding volume of nitrogen in the other. The difference of pressure of the nitrogen in the two bulbs is measured by withdrawing a known volume of mercury from a small reservoir attached to the appropriate side of the dilatometer. The advantage over other dilatometers used for the same purpose lies in the possibility of obtaining definite and steady

conditions of temperature.

R. C. Johnson and H. G. Jenkins. The band spectra of silicon fluoride. Some eight band systems or groups—all except one new—are recorded and attributed to silicon fluoride. Two band systems attributed to a fluoride of sulphur were encountered in the experimental work. To two of the band systems of silicon fluoride, named  $\alpha$  and  $\beta$ , have been assigned vibrational quantum numbers. A third, the  $\gamma$  system, is shown to be related, and a fourth system has been partially analysed. The heat of dissociation of the FS1-S1F molecule is of the order of 5 volts or 116000 calories.

T. W. Wormell: Currents carried by point-discharges beneath thunderclouds and showers. Upward currents were found generally greater than downward The maximum value attained during a shower by the discharge current from the single point, which was at a height of about 8 metres, was frequently between 1 and 10 microamp. The net quently between 1 and 10 microamp. The net quantity of positive electricity discharged during a shower was commonly of the order 10-2 coulomb. The total net transfer of positive electricity from the point during 8 months was  $0.17_3$  coulomb, the quantities passing upward and downward being  $0.25_5$  coulomb and  $0.08_2$  coulomb respectively. The transfer of electricity observed is thus opposite in direction to the normal ionisation current of fine weather, and also to the convection current carried by precipitation. In the case of several showers, the phenomena observed consisted of a downward current as the cloud approached, a large upward current beneath the centre of the shower, and a downward current towards the end of the shower. The distribution of electric field below the cloud suggests that in these cases the cumulo-nimbus cloud was bipolar,

with upper charge positive, and lower charge negative.

A. M. Taylor and E. K. Rideal: The effective moment of the sulphur complex. The absorption spectrum of sulphur has been examined in the infrared between  $1\mu$  and  $14\mu$ . The chief maxima occur at  $7.7\mu$  and  $11.9\mu$ , and the form of curve is the same for rhombic, prismatic, liquid and plastic varieties, the maxima being very little shifted from one modification to another. The depth of the absorption band at 11  $9\mu$  is somewhat remarkable, in view of the absence of charged ions in the element. The 'effective charge' on the vibrating particles in sulphur is about 0.7 electron, indicating an interatomic linkage which approximates to one of heteropolar character. Assuming the group  $S_2$  to have an electric moment, a structure is suggested for the larger group  $S_{16}$ , and the electric moment of the group  $S_2$  is calculated. The value agrees with that determined from the infra-red spectrum.

(To be continued.)

#### PARIS.

Academy of Sciences, June 7—Ch. Depéret. An attempt at the Phocene history of the Seine basin—Edouard Imbeaux: The great Artesian basins of Russia in Europe.—Léon W. Cohen: The non-equivalence of the definitions of dimensions of Menger and Urysohn—Gr. Fichtenholz: Suites of harmonic functions.—Henri Chrétien: Panoramic kinematography by means of ordinary apparatus.—R. de Mallemann. The general molecular theory of rotatory power—P. Bonet-Maury: The vaporisation of polonium. The polonium preparation is carried on a ribbon of nickel, the latter being heated electrically to a known temperature. Just above this is placed a copper vessel containing liquid air and the volatilised polonium is completely deposited on this cooled surface. This apparatus has been used to determine the law according to which the volatilised atoms of polonium are distributed in space when the heating is carried out in a vacuum—F Blondel The structure of the ensemble of the south-east of French Indo-China.

#### BRUSSELS.

Royal Academy of Belgium, Jan. 8 — Octave Dony and Francis Meunier: The electrolysis of the insoluble compounds of the alkaline earths and, in particular, of barium carbonate. A comparative study of the conditions of electrolysis of barium carbonate in suspension in a solution of chlorate or perchlorate of the same metal, in the case where the two electrodes are separated by a diaphragm (Siemens and Halske method), and in the case where the use of a diaphragm is replaced by that of a mercury cathode. The conditions of yield are found to be more favourable in the latter method.—Th. De Donder: The extremals described by electrons and electrified particles.—F. Dacos: The specific inductive power of phosphorescent substances. Experiments are described showing that for a series of preparations of calcium sulphide containing an increasing proportion of impurity (bismuth) the specific inductive capacity of the various substances as well as the intensity of the light emitted by the phosphorescence follow an analogous law. It has also been shown that the dielectric constant of a phosphorescent substance remains invariable whatever the illumination to which it may be submitted.—E. Dahy: A birational involutive transformation of the plane—M. Bazzin and A. Errera: The logic of M. Brouwer.—R. Moens: Some experiments on the electrodeless discharge with maintained waves.

Feb. 5.—Th. De Donder: Extremals described by electrons and electrified particles. (Second communication.)—P. Swings: The quasi-elliptic orbits, Riemann potentials, and central forces.

#### GENEVA.

Society of Physics and Natural History, May 5.—L. Reverdin. Study of the fauna of the station of Sumpf (Zoug), bronze age—The author has identified 298 bony remains belonging to 11 species in addition to man, amongst which he gives a description of ox, sheep, and dog, the last represented by two kinds, the dog of the bronze period and that of the peat period. The fauna corresponds with that of Alpenquai, at Zurich—R. Chodat: Two new algae in the flora of the Lake of Geneva. The author has observed in the water of the lake in large quantities a new species

of Pandorma and a new Erueigenia, not before noted in spite of twenty-five years of careful research. It is a rare case of epidemic stocking in a lake basin in floral equilibrium.—H. Lagotala Contribution to the study of the ancient strands of the Mediterranean. A strand 8 or 9 metres high is visible at Cavalaire (Var., France). It is marked by holes due to molluscs and corresponds well to the lines of strands pointed out by Depéret, Caziot, and others

#### WASHINGTON

National Academy of Sciences (Proc., Vol. 13, No. 4, April) —J L. Walsh. On the expansion of harmonic functions in terms of harmonic polynomials.—B. P. Gerasimovič: On the correction to Saha's formula for small deviations from thermodynamic equilibrium. The applications of ionisation theories in astrophysics assume that the layers in which spectral lines arise are in thermodynamic equilibrium. This can give only approximate results. The correction for small deviations from equilibrium is calculated. For the sun, it is nearly unity because the 'boundary' temperature (Schwarzschild) does not differ from the temperature measured spectrophotometrically, for some of the stars showing emission lines it may be of importance.—Worth H. Rodebush: Chemical constants and absolute entropy. Using the specific heats at low temperatures, the vapour pressures at low temperatures, and the specific heats of the liquid metals, the entropies of potassium and sodium vapours at 298° K and 1 atmosphere are found to be 38 2 and 36 7 respectively. These values suggest that the thermodynamic probability of a system is a definite number and justifies the concept of absolute entropy.—Richard C. Tolman, Don M. Yost, and Roscoe G. Dickinson On chemical activation by collisions. In discussing activation by molecular collisions, the amount of energy available is generally only slightly in excess of that required for activation. This entails the unlikely effect that practically all the energy after a collision passes into one of the colliding structures. Further, the hypothesis leads to very large values for the de-activational diameters, and also to the use of different diameters for activational and de-activational collisions.—Alfred C. Robertson: A case of negative catalysis in a homogeneous system. Vanadic acid (ammonium vanadate +acetic acid) greatly diminishes the rate of decomposition of hydrogen peroxide by potassium dichromate. It is suggested that the intermediate perchromic acid is converted into the less reactive pervanadic acid, thereby decreasing the total rate of decomposition.—T. H. Gronwall: On the determination of the apparent diameters of the ions in the Debye-Huckel theory of strong electrolytes. -Joseph W. Ellis: New infra-red absorption bands of methane. Five new bands at and between  $\lambda 1.15 \,\mu$ and  $\lambda 1.80 \mu$  were observed. Certain bands at and between  $\lambda 1\cdot 15~\mu$  and  $\lambda 7\cdot 67~\mu$  seem to be associated with the C-H linkage.—Ernest O. Lawrence and J. W. Beams · On the nature of light. By passing light from a zinc spark gap through a Nicol prism, a double Kerr cell consisting of two sets of parallel brass plates in carbon disulphide and oriented at right angles to each other and at 45° with respect to the electric vector of the polarised light, and finally through another Nicol prism 'crossed' with respect to the first, it was possible to obtain short 'segments' of light of variable length. The effect of these pulses was measured by a potassium photo-cell. Such segments might include fractions of light quanta, which would be unable to eject an electron photo-electrically; also, the time taken by the 'segment' to pass over an electron might be less than the time required to eject an electron. Thus, the photo-electric current would be small or zero. The results

show that light quanta, as generally understood, are less than 3 cm long, and that an electron absorbs a light quantum in less than  $10^{-10}$  sec —L. A. Sommer: Bands in the extreme ultra-violet spectrum of a helium discharge. Lyman's so-called line at λ600 3±0.6 appears to be a band corresponding to a transition  $1^1S-2^1S$  in the helium molecule.—W. N. Birchby. White-light interference fringes with a thick glass plate m one path (Part 2).—G W. Stewart and Roger M. Morrow Molecular space array in liquid primary normal alcohols · the cybotactic state X-ray circular diffraction haloes in these alcohols show that one distance observed increases by approximately 1.54 Å.U. with each CH2 group added to the chain, while another distance, varying from 4.6 Å U. for lauryl to 3 8 Å U. for methyl, seems to be due to the separation of the molecules perpendicular to the The results indicate a space array permitting of molecular mobility in the liquid which is termed 'cybotaxis.'—Carl Barus. Pinhole probe measure-ments with massive cylindrical air columns.—Jared Kirtland Morse: Atomic lattices and atomic dimen-Models of cubic and hexagonal lattices can be built up using a modified cubic atom concept, and possible atomic radii are calculated. One striking result is that the atomic radius of the carbon atom in diamond is  $0.77\,\text{Å}$  U. while in graphite it is  $0.75\,\text{Å}$ .U., and both lattices consists of cubes having one corner in common.—Paul S. Epstein. The magnetic dupole in undulatory mechanics.—R. A. Brink and C. R. Burnham: Nucleus and cytoplasm in relation to differential pollen-tube growth. 'Sugary' maize plants bear a lower proportion of 'waxy' seeds than plants carrying the dominant 'non-sugary' factor. Recognising two stages of growth in the pollen-tube, dependent respectively on (1) the food reserves of the pollen grain, and (2) on food materials supplied by the tissues of the pistil, a differential rate of growth is found in the first stage —J. T. Buchholz and A. F. Blakeslee: Abnormalities in pollen-tube growth in Datura due to the gene 'tricarpel.' Many of the pollen-tubes from pollen carrying the 'tri-carpel' gene burst at their tips and the protoplasm is extruded, leading to a deficiency in 'tricarpel' individuals in crosses.—M. Demerec: Magenta-alpha -a third frequently mutating character in Drosophila virilis.—Dontcho Kostoff: Pollen-tube growth in Lythrum salıcarıa. Pollen-tube growth in fertile pollinations is accelerated in the later stages in contrast with that occurring in unfertile pollinations.-William Hovgaard: Bending of a quasi-ellipsoidal shell with special reference to rigid airships. Two deformations other than simple bending are involved: (a) a downward movement of the framework due to shearing deflexions of the whole ship; (b) a deformation of the transverse frames due to unequal loading. -H. Walter Leavitt and John W. Gowen: Influence of iron content on mortar strength. The tensile strength of mortar (after both 7-day and 28-day periods) increases with increasing iron content in the sand used; compressional strength is unaffected.

# Diary of Societies.

SATURDAY, July 16.

Institution of Municipal and County Engineers (Eastern District Meeting) (at Guildhall, Cambridge), at 2.

TUESDAY, JULY 19.

ROYAL SOCIETY OF MEDICINE, at 5 30.—General Meeting

SATURDAY, JULY 23.

PHYSIOLOGICAL SOCIETY (in Physiological Laboratory, University, Edin-

#### CONGRESS.

JULY 19 TO 22.

BRITISH MEDICAL ASSOCIATION (at Edinburgh).
Tuesday, July 19, at 8 r m.—Sir Robert Philip: Presidential Address.

No. 3011, Vol. 1201

Wednesday, July 20 (in McEwan Hall), at 8 PM —Lister Centenary Celebration, presided over by the Earl of Balfour, and addresses by Sir W Watson Cheyne, Bart, Prof Tuther, Prof H Cushing, and

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[July 16, 1927

| Hadwooday, July 20 (in McEwan Hail), at 8 r m — Lister Centenary Celebration, previded over by the Earl of Balfour, and addresses by Servart Choyne, Bart, Prof Tuther, Fort H. Uviling, and Dr J. Stewart Choyne, Bart, Prof Tuther, Fort H. Uviling, and Dr J. Stewart Choyne, Bart, Prof Tuther, Fort H. Uviling, and Dr J. Stewart Choyne, Bart, Prof Tuther, Prof H. Uviling, and Dr J. Stewart Choyne, Bart, Prof Tuther, Prof H. Uviling, and Dabetes Mellitus — Discussion. The Treatment of Acute Osteonryshirs by Primary Displays—Sensions. Growth in his Pathological Relations—Discussion Crowners of Chinical Methods of Administration and Therapeutic Uses of Oxygen—Prof J A. Gunn Expectorants—Discussion. Clinical Methods of Administration and Therapeutic Uses of Oxygen—Prof J A. Gunn Expectorants—Discussion Clinical Methods of Administration and Therapeutic Uses of Oxygen—Prof J A. Gunn Expectorants—Discussion Neurological and Mechanical Factors underlying Immobility of the Vocal Goids, then Diagnosis, Prognosis, and Principles of Treatment—N. Retirects. Some Discussion Science of The Prof Oxygen Charles of Medical Pathological Charles of Medical Relation Administration—Municipal, School, Factory, etc.—be concentrated under a Single Department, and the Inmediate Control in each Executive Area is vested in a Single Individual —Discussions—Administration—Municipal, School, Factory, etc.—be concentrated under a Single Department, and the Inmediate Control in each Executive Area is vested in a Single Individual —Discussions—Administration—Administration—Grant Profession—Administration—Administ



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#### Education and Science.

THE beginnings of education have not hitherto seemed very relevant to the interests of scientific men. They have been anxious to make good the place of science in all the important later stages of education, not merely for professional training, but also as an essential part of any wide, civilised perspective appropriate to our time. They have offered their own contribution of method, in the heuristic form, as a valuable and typical educative experience. But whilst their professional demands have been more or less satisfied, the cultural assimilation of science makes slow progress. It is still treated as an alternative to the humanities. It still appears to many educated people as a form of specialism irrelevant to general education.

Perhaps it is the belated and limited introduction of science which perpetuates this disjunctive view and prevents the true value of science for liberal education from being seen. If it is thus made to appear as a new and separate beginning in knowledge, leading away into a special field, it can scarcely do otherwise than disconnect this field, and the limited number who enter it, from the general body of future educated opinion which stays outside and indifferent.

If, however, the world of science is only the common world greatly enlarged and much more adequately known, and if its methods are the methods by which such more adequate knowledge is achieved, then guidance to some understanding of this would clearly need to be recognised as a major aim for any humane education. If that aim were defeated by any late and separate beginning in science, that would be a serious limitation, not of the educative value of science, left unused, but of the prevailing order and method of education which kept it so. It would then be necessary to trace the disjunction between science and the common world back to its source in the current educational process and to seek to remedy it there. The earliest stages would thus become very important and the question would arise whether they could not be so ordered from the beginning that this false disjunction could never arise at all.

Specialisation would come at its due late time, as now, for those whose interest led them to it, but it would be continuous with a liberal general education which aimed at making some representative sense of the scope, aims, and methods of scientific knowledge a common possession for all.

It is this representativeness that would be aimed

at, graded from the first beginnings of concrete knowledge in the common world to its typical highly developed and organised forms. The value of science for education would then lie in the continuity of its character and history being made available for a parallel continuity of development in knowledge of the child. The approved method of starting science learning at some rudimentary concrete beginning, at whatever age it is begun, which can easily be made to seem highly artificial, would receive its natural meaning if it set out from the age where the simplest kind of direct knowledge-learning actually began.

We should thus be proposing not another fixed programme or schedule, but a difficult and important problem in liberal education. It would become a matter for careful and scientific study what was the best manner and sequence of procedure, in order to preserve the continuity of method and perspective at which we should aim. We should have a valuable initial advantage over formal subject-knowledge and subject-teaching because we should be working with a powerful native educative interest in the child, but it would be a part of our problem, and a very central one, to preserve this interest and to carry it on.

The first direct knowledge-learning from which we should start would thus be that which emanates from the child itself, spontaneously and usually actively. Most normal children of, let us say, 4-5 years of age show a lively, inquiring curiosity in the world around them, and want to know how things work, what they are, how they are made. Their curiosity seeks knowledge and takes pleasure in finding it. We should be endeavouring so to guide, reinforce, and develop this curiosity of the normal child in the world around him that it could pass continuously by its own activity into the same interest, informed and organised, in the world—not different but greater—of science.

We should, of course, not assume that this could be done, but should be content with not laying down in advance that it could not be done. A critical examination of all the avoidable ways of preventing, restricting, discouraging, misdirecting, or confusing the advance of knowledge, familiar to us in the history of knowledge of the race, but not all and always avoided in that of the individual, would show the evidence against us to be at least inconclusive. It would be possible that the interlocking quality of the older system of formal knowledge, formal teaching, and enforced receptivity gave rise to what evidence there was; and whilst this system would have to continue in some partly mitigated form so

long as we knew no other way, it would be important to try any way in which we might conceivably learn better. To endeavour to establish a high road from natural curiosity to representative scientific knowledge would at any rate be to test one possible way.

In the meantime we should have this initial interest in the child to work upon, to stimulate and encourage, to refer to active, direct inquiry, to provide with graduated experience of the relation between such inquiry and discovery, and to carry on to a more and more developed sense of the terms on which knowledge could be gained, tested, and enlarged in an enlarging world

This would then make a formidable problem for highly skilled research. It would, of course, only be a part of the problem of progressive education, since for the point of view here adopted, scientific knowledge is far from being the only kind of knowledge, or knowledge the only aim of education. Thus, for example, taking knowledge alone, a historical perspective upon science itself, and this in turn set in some just proportion in a larger historical whole, would clearly be a like condition and eventual aim for the process of scientific educa-But there would be reason for sugtion itself. gesting that the scientific way would be the first, easiest, and most natural way of beginning education and establishing some foundation of direct experienced knowledge and its way of increase, for later indirect knowledge to be built upon.

That would be in full accord of principle with the recent trend of enlightened educational theory, which, coming more and more under the influence of psychological knowledge, itself advancing, aims at grading the processes of education from the start so that they should flow easily and naturally out of the child's development. In practical progress it has inevitably remained conditioned by the powerful tradition which it has sought to change but within which it has had to work; and its scope has thus been rather to liberalise old methods and subjects and gradually to bring them closer to the child, than to consider any more radical possibilities of theory. For the further advance of education, however, it is necessary that these more radical possibilities should be fully worked out, and, according to their promise, practically tested.

Given now the aim of adaptive grading and psychological integration, and given also the inherent limits of a vast deal of traditional knowledge which can only be communicated verbally and by methods more or less unrelated and arbitrary, it is a crucial problem for psycho-

logical education whether there is no other knowledge, which can be developed first, from natural roots; and carried on continuously by the same methods to a high integration, as a pattern and framework of what knowledge can be. The natural continuity of science provides a possible solution alike for a first beginning of education in knowledge and for its organic development later

To make this solution actual, however, there is needed practical research of a high order, fundamental in character, by many investigators, bringing wide resources and high qualifications to bear. But if education is important, research in it is important, and its pre-conditions must be fulfilled. We must assume that education may technically only be at its beginnings in order to look for definite ways of verifying this and to press for adequate and multiple research.

Some interesting commencements have been made in recent years, though still somewhat entangled in general programmes of practical education. Thus the Maison des Petits attached to the Institut Rousseau at Geneva, and the Walden School in New York, may be instanced. Perhaps more directly relevant is the Malting House School at Cambridge which specially aims at exploring the educative use of introductory science from the outset of education. During three years, the response of children of 4-7 years of age under free conditions to opportunity and stimulus for the direct discovery of many kinds of natural knowledge-mechanical. physical, biological—has been observed and studied. As, however, this remains an unseparated element in the general plan of humane education of the school, and the number of children is small, any encouraging results obtained can so far only be suggestive. A recent prominent advertisement of this school has set very high standards for a more specific investigation in the same field, and the result should prove significant, but since scientific work is nothing if not cumulative, it must eventually be judged less by what it does than by what it begins. What is important, therefore, is continuance, and a sustained movement of similar work. The simple, obvious principle on which the research attitude is based, that facts are only as unalterable as all the conditions on which they depend, and beliefs only as valid as all the assumptions on which they rest, is as applicable to education as to engineering. It should become as much a commonplace in the former as in the latter field that no a priori assumptions, but only the quality, extent, and coordination of actual research done, can determine how much progress is—or is not—possible.

# A Complete Catalogue of Scientific Periodicals.

A World List of Scientific Periodicals published in the Years 1900-1921. Vol. 2 · Abbreviated Titles and Locations of Sets. Pp. xii+344. (London: Oxford University Press, 1927.) 45s. net.

THIS second volume of the "World List of Scientific Periodicals" contains the abbreviations proposed for the titles of the 24,028 periodicals the full titles of which were given in the first volume, a notice of which appeared in Nature of Sept 19, 1925, p. 419. There is a supplement containing 658 further titles as to which information has been received since the publication of Vol. 1. There is also a list of abbreviations proposed for the titles of the reports of some 140 international congresses.

The titles in the previous volume were numbered. In this volume the same numbers appear, followed by the proposed abbreviations. We think, however, that the reader will find, in most cases, that the abbreviations are full enough to make it unnecessary to refer to Vol. 1. Thus the meaning of such an abbreviation as "Bull. Soc. Sci. Nat. Phys., Montpellier," would appear fairly obvious, though, if the reader should wish to quote the exact wording of the title, he would do well to make certain by looking at Vol. 1, for it is explained that such an abbreviation as 'Sci.' may mean science, sciences, or scientific, while 'Bl.' may stand for Blatt or Blatter.

For the convenience of those who may wish to make a card catalogue, the volume is printed on one side only of the paper, so that it can be cut up and pasted on cards

The outstanding feature of this volume, and that for which British science will be most grateful, is the information showing the libraries in which a periodical can be consulted. Those who possess this volume need not fear to be told by a librarian that the journal they wish to consult is not in his library, for they will know beforehand which library to visit. The libraries which have furnished lists of the periodicals on their shelves are in the cities of Aberdeen, Aberystwyth, Birmingham, Bristol, Cambridge, Cardiff, Dublin, Dundee, Edinburgh, Glasgow, Leeds, Liverpool, London, Manchester, Nottingham, Newcastle. Rothamsted, St. Andrews, Sheffield, and Swansea. In London 27 libraries have given full information as to the scientific periodicals they possess, in Cambridge 27 libraries, in Edinburgh 21, in Oxford

19, in Glasgow 9, in Manchester 7, and in Birmingham and Sheffield 6 each. Altogether there are 112 libraries in the list, and against every periodical in the "World List" there is a note showing in which, if any, of these libraries it is available.

It may happen that in some library the series of a particular periodical is incomplete. In the "World List" an attempt is made to give full information as to gaps in the sets. Knowledge that volumes are missing from a series in a library is not only valuable to those who use that library, but also will remind the custodians of the institution that these missing volumes should be supplied as soon as possible.

While it is satisfactory to note the large number of periodicals that are to be found in one or other of the British libraries, there remain very many which, according to this list, cannot be consulted in Great Britain. It would be worth while to make a close study of the entries to see whether some of these missing journals might not take the place of others of which there may be an unnecessary number of copies.

The origin of the "World List of Scientific Periodicals" was explained in the notice of the first volume. At the suggestion of Sir Sidney F. Harmer, until recently Director of the Natural History Departments of the British Museum, and Dr. P. Chalmers Mitchell, secretary to the Zoological Society, the Conjoint Board of Scientific Societies appointed as a Committee Sir Sidney Harmer, Mr. F. W. Clifford, Sir Richard Gregory, Dr. P. Chalmers Mitchell, Dr. A W. Pollard, and Prof. W. W. Watts to consider the possibility of preparing a list of the chief scientific periodicals, with an indication of the libraries in which they might be consulted. This Committee decided to index scientific periodicals in existence from Jan. 1, 1900. Details as to the sets of these periodicals before 1900 may also be given. It was soon found that the cost of preparation and publication of a work of this magnitude could not be covered by subscriptions and sales. Help was given by Sir Robert Hadfield, Mr. Robert Mond, and the trustees of the Carnegie United Kingdom Trust.

In 1923 the Conjoint Board came to an end, but it had previously entrusted the "World List" to Sir Arthur Schuster, Mr. Robert Mond, and Dr. P. Chalmers Mitchell, who formed a company limited by guarantee to complete, own, and conduct the "World List of Scientific Periodicals." This company was incorporated with a council of management consisting of Dr. P. Chalmers Mitchell (chairman), Sir A. Schuster, and Mr. R. Mond.

Miss Joan B. Procter became secretary. The work of the council is voluntary, and by the articles of association no benefit can be distributed to the members of the company. The company holds the copyright of the "World List" and, at a future date, if funds should permit, it will arrange for the issue of reprints and supplements It is also provided in the memorandum of association that if some stronger body were willing to take over the duties and responsibilities of the company, then any surplus funds which may have accrued should be handed over to some "other institution or institutions the objects whereof shall be certified by the President of the Royal Society of London for the time being to tend to the advancement of science" It is therefore quite clear that any one wishing to advance the interests of scientific research by helping to make its published results accessible, may contribute to the funds of this company, confident that his money will not be used otherwise than in the interests of science.

Much skill and an enormous amount of labour have been required in collecting and arranging the titles of 25,000 periodicals, preparing abbreviations, and indicating where the periodicals may be found.

The trustees of the British Museum, on the recommendation of Dr. Pollard, then Keeper of Printed Books at the Museum, supported by Sir Frederic Kenyon, Director and Principal Librarian at the Museum, allowed the compilation of the list to be undertaken by the staff of the Museum as part of their official duties.

The co-operation of the librarians of a large number of libraries in the United Kingdom has made it possible to state the libraries, if any, in which each periodical is to be found.

The original editor of the "World List" was Dr. A. W. Pollard, who was assisted by Mr. W. A. Smith. Mr. Smith, with advice from Dr. Pollard and Dr. P. Chalmers Mitchell, has undertaken the chief burden of editing this second volume Among difficult problems with which the editors have had to deal were those arising from changes in the titles of periodicals. In the reports from the various libraries there was found a want of agreement as to the date on which a change of title had taken place. Much labour was required before these dates could be fixed. The problem was not confined to changes of title during the period 1900-1921 covered by the "World List," for libraries possessing sets of periodicals which started before 1900 and continued beyond that date, were allowed to give details of earlier years. It has therefore been necessary to decide as to the identity of a periodical

under the different names it has borne during its existence

The date at which a periodical ceased to exist has been denoted by an asterisk. The editors found that very few library catalogues give accurate information on this point. They have taken great pains to discover the exact date of the 'death' of all periodicals which have ceased publication to be found in libraries in Great Britain, but they are not able to guarantee that the information on this point regarding periodicals of which no set is preserved in the country is always correct.

Much importance attaches to the choice of the abbreviations, for these are intended to be used by authors in referring to articles in the journals. The rule that the order of the words on the titlepage of a journal should be followed in the abbreviation has been adopted. Thus the Journal of the Chemical Society of London is abbreviated "J. Chem. Soc. Lond" and not "Chem. Soc J." It is true that this method separates the different publications (Proceedings, Reports, Transactions) of the same Society, but it makes it much easier for the reader to reconstruct the full title. It is greatly to be hoped, for the sake of uniformity, that the abbreviations used in the "World List" will be accepted as the standard of general practice.

The place of imprint is omitted except when needed to distinguish periodicals with the same title; but when the abbreviated form would leave the language of the original uncertain, the imprint is added for all except the best-known language of those between which confusion could arise, the order of familiarity being fixed as English, French, German, Italian, or Spanish. This strikes one as a rather curious rule. We think it would have been better to give the town of publication in all cases except those in which that town is mentioned in the title.

One cannot help asking whether it is really necessary that there should be so many periodicals dealing with science. Perhaps the publication of this list may suggest that some of these journals might amalgamate and so lessen the number which the scientific worker may be called upon to consult.

The two volumes of the "World List" will be of very great value not only to librarians but also to all who have an interest in science. Those who have taken part in their preparation and the Oxford University Press are to be heartily congratulated. All scientific workers will thank Dr. P. Chalmers Mitchell for the resolute way in which he has guided the enterprise through its difficulties and finally brought it to a successful conclusion.

### Physiological Genetics.

Physiologische Theorie der Vererbung By Prof. Dr. Richard Goldschmidt Pp vi + 247. (Berlin: Julius Springer, 1927) 15 gold marks.

PROF. GOLDSCHMIDT has given biologists a very stimulating book. It may be incorrect or incomplete in a number of individual points, but the author will not, we suspect, mind this so long as the book is widely read, and read in the spirit in which it is clearly intended, namely, as a pioneering venture into the new and almost uncharted sea lying between genetics and Entwicklungsmechanik, which, with our author, we may call physiological genetics.

It is now fifteen years ago that Goldschmidt published his first paper on the problem, which will be as classical to students of physiological genetics as is Mendel's work on the pea to students of simple (or distributional) genetics—the problem of intersexuality in Lymantria. There, as is well known, he was able to show, first, that intersexuality was produced by a lack of balance between definite genetic factors for maleness and for femaleness; secondly, that this imbalance revealed itself in the time-sequences of development—the intersexes were animals which began their development of the 'right' sex, but later became switched over to the development proper to the other sex, and thirdly, that the greater the upset of balance, the earlier did the 'wrong' sex come to have the upper hand. From these facts Goldschmidt drew the conclusion, which appears as unassailable in its broad outline as is Mendel's conclusion of purelysegregating unit-factors, that the male- and female-determining factors exist in a number of related forms (presumably multiple allelomorphs) differing, inter alia, in their quantitative potency; and that the more potent differ from the less potent in effecting the same reaction more rapidly

In the present volume Goldschmidt seeks to universalise this view, and advances the theory that all Mendelian genes are concerned fundamentally with the rates of developmental processes, and that the differences between allelomorphs can always be reduced to, and indeed best thought of as, differences in such rates of action.

Let us say emphatically at the outset that this is an extremely fruitful view-point. Most geneticists, so long as their experiments led to the discovery of definable gene-units, have been perfectly content to note the mere fact of relationship between gene and character-effect, without attempting to think out how that relationship was brought about.

'The gene for bar-eye,' 'the factor for wrinkled seeds," the gene which produces reduplicated legs in Drosophila kept at low temperature,' 'lethal factors,'-for the most part geneticists have been content with such purely descriptive statements. There have been honourable exceptions. Sewall Wright, following Onslow, has given a most illuminating analysis of all the coat-colour genes of mammals, which is based upon the idea of the interaction of two or three quantitatively-controlled pigmentary reactions; Miss Wheldale has attempted to analyse the relationship between the brochemistry and the genetics of anthocyan pigmentation in plants: the recent beautiful work of Plunkett (J. Exp. Zool., 1926) on the mode of action of bristle-inhibition in Drosophila is one of the greatest value: and there are other examples. But they are all exceptions.

Goldschmidt attempts to generalise. Let us give a few examples. He himself has worked out the larval coloration of Lymantria dispar. The older geneticists would have said that there existed a number of multiple factors for melanin production, several of which show reversal of dominance. Goldschmidt shows that all the factors affect the rate of production of melanın (or other timerelations see later), and that the so-called reversal of dominance occurs only when factors are present, the major part of whose effect in increasing the amount of melanin falls in the larval period; for only then will the original condition of little or no pigment and the final condition of much pigment both be visible, together with all intermediate conditions. Quicker acting genes will hurry the pigment up and make the larva already dark at hatching, slower acting ones will leave it pale right up to pupation.

In Drosophila, dozens of eve-colour and eve-shape genes are known, and their linkage-relations have been ascertained, but the how of their action has scarcely been thought of. Goldschmidt, without pretending to advance more than a formal explanation in terms of physiological genetics, points out that we have in any case to consider the following timereactions: (1) that of the process which determines the differentiation of the eye-rudiment. (2) As with other differentiations, if the eye-determination does not take place by a certain time, other processes are at work which irrevocably determine the cells in some other way—in this case as ordinary epidermis. If (1) is too slow, or (2) too speedy, an eyeless animal is the result. (3) The number of facets depends on the number of cell-divisions taking place in the 'eye-determined' material. Goldschmidt assumes that these cell-divisions are inhibited when the end-products of some process, also with its specific rate, have reached a certain concentration. Changes in the rate of either (1) or (3) will therefore bring about changes in facet-number, as in bar-eye, etc. Finally, he treats the colour-mutations from the same point of view as in his Lymantria larvæ. Now it is clear that many assumptions have been made, some of which, such as (3), may very likely be replaced by better. None the less, it is equally clear that new ways of thinking and new methods of experimental attack are at once suggested by this treatment.

One further example, this time of fact rather than theory. Goldschmidt and his pupils have been able to show that the wing-pigmentation of Lepidoptera is brought about by a curious interrelation of developmental processes The scale rudiments develop at different rates, so that before any pigment exists in the wing, the future pigmentation can be read off as a structural shadow-pattern. The various pigments appear to be produced in the body at different times, and to be shot out into the wings when ready. In the wings they can only be deposited in scales which are at a certain stage of their development: they pass over the rest. Thus the relative rates of scale differentiation and of pigment production both contribute to the actual pattern. Goldschmidt has further been able to show that the melanic form of Lymantria monacha differs from the normal, not in an excess production of melanin, but in a greater development (brought about by a greater rapidity of action of the corresponding genes) of the scales which are in the sensitive stage when the melanin-flood is generated.

In a number of other points Goldschmidt is very suggestive. The phenotypic identity of two conditions, one of which can be shown to have been brought about by altering the organism's environment, the other by altering its genetic constitution, has often been regarded as a grave stumbling-block. Goldschmidt points out, however, that if all visible characters depend upon genecontrolled rates of developmental processes, then this identity is what should be expected.

Valuable as the book is, however, it calls for one or two criticisms and caveats. Goldschmidt has not entirely rid himself of the habit, familiar to students of his earlier works, of providing illustrations which appear to represent curves of accurate quantitative processes without sufficiently warning the reader that they are in reality nothing of the sort, but merely very useful diagrams of possibilities to assist the visualist.

In his earlier works the curves for production of male- and female-determining substances in Lymantria—now copied into all the text-books fell into this category. In the present book, although it is true that warning has often been given, this is by no means always so. theoretical curves for the larval pigmentation of Lymantria (pp. 56-57) are a case in point. That on p. 57 is a chemical impossibility. As a matter of fact, the actual experimental curves obtained (p. 55) can readily be interpreted by adopting two subsidiary hypotheses—that not only the rate of pigment-production is controlled by genes, but also (1) the final density of pigment (equilibriumlevel) obtained, and (2) its time of onset. Both these statements actually hold good for the pigmentation of the eye of Gammarus, and probably in general (Ford and Huxley, Brit. J. Exp. Biol.,

Even where at first sight quantitative accuracy appears to have been attained, this may not turn out to be really the case. Goldschmidt, for example, has a very able discussion on the whole problem of bar-eye in Drosophila (p. 59 et seq.), which at first sight seems demonstrative. Certain assumptions, however, turn out not to be justified: and as a matter of fact, a careful analysis of the figures which I undertook, with the able assistance of Dr. C F. Pantin, has convinced me that Goldschmidt's explanation will not work quantitatively in its present form. On the other hand, I am perfectly convinced that it is on the right general lines, and that if systematic experiments and embryological studies on bar-eye, based on Goldschmidt's ideas, were undertaken, we should soon find ourselves in possession of really accurate quantitative laws bearing on the action of genes in development, and of general application.

This brings me round to my starting-point, and I will merely conclude by recommending the book to the notice of all interested in genetics, developmental physiology, and, indeed, general biology.

J. S. HUXLEY.

### Ectoplasmic Matter.

Clairvoyance and Materialisation: a Record of Experiments. By Dr. Gustave Geley. Translated by Stanley de Brath. Pp. xvi+401+51 plates. (London: T. Fisher Unwin, Ltd. (Ernest Benn, Ltd.), 1927.) 30s. net.

THE late director of the International Metapsychic Institute, Paris, was an enthusiastic exponent of what he and his associates termed 'metapsychic science.' Although this large volume contains nothing new in principle for the student of mediumistic phenomena, the collected results and studies of Dr. Geley's researches mark the end of many decades of controversy as to the reality of the phenomena

It must now be admitted that the various kinds of lucidity and of ectoplasmic formation are facts of experience as actual, though as sporadic, as hypnotism, insanity, or physical deformity. Geley had the qualifications for research work such as are required for observations 'in the field' and for recording the states and behaviour of pathological and mental cases. He was an experienced and capable investigator and his introductory explanations of the conditions requisite for metapsychic research should be read by all those engaged in it. If his precepts were followed there would be fewer than there are at present.

The incentive to devote one's life to these investigations must be either a fixed idea or a temperamental interest in abnormal and degenerate human types. Geley's temperament probably led him into this work, for his only prepossession seems to have been a harmless attachment to a word-"dynamo-psychism"—from which he sought in an earlier work, "From the Unconscious to the Conscious," to evolve a philosophy. In the annals of science it is usually the innovator who enunciates the principles or laws operating in new fields of investigation; others further confirm, elaborate, and tabulate. Geley was not an innovator, but he and other men of science have about completed the survey as regards terminology and classification of evidence and material. There is no scientific or ethical justification, however, for the repetition of these experiments by others. Flourney, Joiré, Schrenck-Notzing, Morselli, Richet, Osty, Geley, and others have established the facts without any religious or spiritualistic implications. Continent spiritism and metapsychics are not synonymous, as the layman, and even some men of science, in Great Britain, believe. These facts can be accepted, just as we acknowledge those guaranteed by specialists in any other research work where the novice and layman do not feel called upon to confirm them by personal investi-They concern chiefly physicians, large numbers of whom have taken part in the experiments described in this and many other books.

Scientific deductions from these facts are now wanted. Nothing new can be learned and no exact knowledge will be obtained regarding the human constitution until the laws governing hypersensible cognition and ectoplasmic matter are formulated. Morselli used analogies from radioactive phenomena to describe certain aspects of ectoplasm. Geley records interesting observations connecting ectoplasmic forms and micro-organisms, especially in regard to the action of light and the production of cold physiological light. Richet suggested that clairvoyance dealing with things was due rather to excessive tactile sensitiveness to emanations with which the article had been charged, unconsciously, by the owner. Others have made the obvious comparisons of radio-telegraphy and television with clairaudience, mental telepathy and clairvoyance

These comparisons are merely suggestive; they may be true, but they are not scientific analogies. Since human nature is a complexity of many kinds of matter, said to be the crown of creation on this earth, we must find analogies that will run right through all the levels of matter, so far known, and correlate these levels in man before the results of metapsychic experiments will have true scientific significance. It is possible that a synthesis of all the sciences relating to man might be achieved could such a scientific correlation be made. A generalisation that includes all the facts of psychic phenomena is necessary, but it must be a principle or law—not a mere word or phrase which may be variously interpreted according to temperament

We know something of the protean possibilities of matter, and this characteristic of ectoplasmic formation is shown by the reproductions of photographs in the book, several of which were published in smaller size in Geley's previous work. plates also include John Tissot's drawing of the lovely apparition named "Katie King" with her Indian guardian, obtained through the mediumship of Eglinton in the early 'seventies, and photographs of the revolting animal and bird forms materialised through the mediumship of Mr. Kluski during experiments conducted by the Polish Society for Psychical Research in 1920. Fifty years of Europe! Could we explain merely this degeneration in the types of materialised forms, the whole subject and its dangers would be under-

Geley inferred from his experiments and believed that there is no essential difference between animals and man; he concluded also that creative genius and mediumship cannot be distinguished in essence, nor can self-conscious clairvoyance and ectoplasmic formation operating during trance. There were no gods, angels, or supermen in his cosmos! Psychodynamic matter is tending to a vague

divinity! What difference this from the 'materialism' for which 'orthodox' science is arraigned? When we leave the solid ground of Nature, unable to understand its operations, word-spinning and idols of the mind masquerade as law

W. W. L

### Lorentz's Theoretical Physics.

Lectures on Theoretical Physics: delivered at the University of Leiden. By H. A. Lorentz. Authorised translation by Dr L. Silberstein and A. P. Trivelli Vol. 1: Aether Theories and Aether Models, edited by Dr. H. Bremekamp. Kinetical Problems, edited by Dr. E. D. Bruins and Dr. J. Reudler Pp. xi+195. (London: Macmillan and Co., Ltd., 1927) 12s 6d net.

URING the last twenty years of his tenure of the chair of theoretical physics at Leyden, Prof. Lorentz delivered short courses of lectures analysing—in the incomparable manner we have learnt to associate with his name-the various aspects of his subject which, during that period, came in for critical examination by the scientific As a result of the energy and enthusiasm of his pupils, these lectures have been preserved in book form, and the present volume is a translation (the originals are in Dutch) of the first of the series. It deals with such subjects as (we quote the titles of the separate lectures) aberration of light, mechanical ether theories; Kelvin's model of the ether; attraction and repulsion of pulsating spheres; inner friction and sliding, treated hydrodynamically; friction and sliding, treated kinetically; Knudsen's investigations on rarefied gases; remarks on Lesage's theory of gravitation: friction and heat conduction in the propagation of sound, kinetic theory of systems of electrons. Richardson's investigations; vacuum contact of plates of different metals; problems in which the motion of electrons plays a part

As these titles suggest, the first section deals with the possibilities and probable hidden secrets of a mechanical radiation-carrying ether and is on lines which were familiar to all physicists twenty years ago. These discussions are now somewhat out of fashion, although a recent attempt—arising out of a complete misunderstanding of certain positive results obtained by Miller in a repetition of the Michelson-Morley experiment—has been made to revive interest in them. They lead almost inevitably to the conclusion which we find here stated so concisely by Lorentz. "To a certain extent these theories are successful, but it must be

admitted that they give but little satisfaction." Actually they can be made more impressive than Lorentz shows, because so many of the difficulties so clearly discussed by him really arise from an attempt to make the ethers explain not only themselves but also matter as well. If we adopt the more reasonable attitude and accept matter as being something over and above the ether—the ribbon tying the knots-then, as Larmor so ably shows in his review of these problems,1 we are not involved in a large number of the paradoxes which otherwise present themselves. Even then, however, it is difficult to avoid the troubles involved mainly in the possibility of the coexistence of two independent statical conditions—electric and magnetic-so we cannot but subscribe to Lorentz's final conclusion

In the other sections of his lectures Lorentz deals with less speculative problems But his treatment of such familiar matters as viscosity and internal friction, the flow of rarefied gases through tubes and orifices, the propagation of sound in gases, and certain problems in the electron theory of metals, are exceptionally lucid and satisfying. Like the rest of Lorentz's work, it combines a most exceptional blend of physical intuition and analytical skill which carries conviction with it at every stage. His concluding lectures on the statistical problems of the electron theory of metals contain an elaboration of an important point which should be noted. The usual simpler forms of the theory lead to a number for the electron content which is at least 1000 times too large. If, however, an internal potential for each electron and characteristic of the metal-suggested by Lorentz in his original memoirs on this subject—is included, this fundamental difficulty disappears and so also do some of the difficulties in the further development of the subject not dealt with by Lorentz in these lectures.

The translators—and publishers—have carried out their task very satisfactorily. Here and there, owing to an obviously too strict adherence to the order of words in the original, an awkwardly constructed sentence holds up the reader, and a few words like parallelepipedon and generatrix are given an unfamiliar—but not misleading—form. These slight blemishes are, however, few and far between, and the book is on the whole worthy of the author whose name appears on the outside; it can in consequence be specially commended to those who are—and were—interested in the subjects with which it deals. G. H. L.

### Our Bookshelf.

The Principles and Practice of Mine Ventilation · being a Treatise on Modern Methods of Mine Ventilation and Machinery, with a Consideration of Deep Mine Problems, Explosions, Fires, Rescue and Recovery Work, and Cognate Subjects By Prof. David Penman and Dr. J. S Penman (London Pp. viii + 303 (London Co, Ltd, 1927.) 21s net. Charles Griffin and

Ventilation of Mines By Prof. Walter S. Weeks Pp x+228. (New York: McGraw-Hill Book Co, Inc; London: McGraw-Hill Publishing Co, Ltd, 1926) 15s net.

For some time past considerable attention has been given to the principles of mme ventilation; institutions, committees, and individuals have been hard at work for some years trying to render our knowledge of this complex subject more accurate, and at the same time to express that knowledge by means of readily intelligible formulæ. It is beginning to be generally admitted that no single formula can quite accurately express all the facts, but there are strong hopes that a reasonably simple formula giving results near enough for all practical purposes may be the outcome. The two books now before us are evidence of the widespread interest that is being taken in the subject; both are fairly satisfactory works within their own spheres, but, curiously enough, these spheres are entirely different. The British book is addressed essentially to students, the American book essentially to mining engineers. Thus it is that in the former it is thought necessary to give such elementary information as that "inversely means in the opposite direction," and to conclude each chapter with a series of questions, adapted apparently to the capacity of elementary students, whilst in the latter attempts are made to discuss such advanced problems as the economics of ventilation, and to solve such problems as, for example, "What is the most economic size of an airway under given conditions?" It must unfortunately be admitted that the author's solution of the problem is neither complete nor correct, but the fact that he attempts to solve it indicates the stage to which the work is carried.

Necessarily there is very much that is common to the two books, and indeed there is a mass of material available which may fairly be said to be the common property of all mining engineers interested in the subject. The British work, however, devotes much more attention to the details of fan construction, which the American writer takes for granted; the former is aware that students must be taught the construction of different types of fan on the market, but the latter assumes that the engineer will be sufficiently familiar with these to require but little additional information. Furthermore, it may be pointed out that whilst the British work practically limits itself to the consideration of the ventilation of collieries, the American work, hailing as it does from California, naturally devotes as much attention to the ventilation of metalliferous mines as to that of collieries. The weakest point

 $<sup>^{\</sup>mbox{\tiny 1}}$  "Æther and Matter." This book should be read in conjunction with these lectures of Lorentz.

in both books is their failure to treat adequately the practically important subject of the testing of fans, although, as might be supposed, this is rather more fully considered by the American than by the British author.

Geschichte der Physik. Von Edmund Hoppe. Pp. viii +536. (Braunschweig Friedr. Vieweg und Sohn A.-G., 1926.) 30 gold marks.

WE can scarcely imagine a more difficult task than the writing of a trustworthy and adequate history of physics. The field is so extensive and the work of reference so enormous that we can readily appreciate that Prof. Hoppe has spent several decades on his undertaking, and in this admirable book he has given the pith of his researches. The treatment is brief but delightfully clear, and in these days of turmoil, when the spirit of revolution has invaded even the realms of physics, it is refreshing to read of the gradual evolution of ideas, based on experiment, from the time of the Greeks through the Middle Ages to the end of last century.

The greater part of the book, almost five hundred pages, is devoted to physics of the Neuzeit, beginning with the close of the sixteenth century, and the book deals in turn with mechanics, heat, optics, and electricity and magnetism, whereby each section is prefaced by a brief statement of the earlier work in that branch of the subject. No attempt is made to deal with the discoveries of the present century, but the continuity of development of the subject is amply portrayed, and we are made to feel that there would have been no 'new physics' but for the classical physics which preceded it. In these days of relativity and quanta, students are perhaps inclined to look askance at the earlier work, and yet much of the remarkable development of our own day is a direct outcome of the discoveries of the end of last century and earlier.

The numerous and comprehensive references to the literature in the text are a valuable feature of the book. The omission of the initials before the names of authors has in a few cases resulted in a certain amount of confusion. Thus in the index (p. 524) there are two entries under the name of Rutherford, but they refer to different persons. The first is the Rutherford (1753–1819) of the maximum and minimum thermometer, whereas the secord is Sir Ernest Rutherford. On p. 177 the names Negrette and Zumbra should surely be Negretti and Zambra, and on p. 505 few people will realise that the 'de Smolan' referred to is in reality Smoluchowski.

The Wilderness of Sinai: a Record of Two Years' Recent Exploration. By H. J. Llewellyn Beadnell. With a Foreword by Dr. D. G. Hogarth. Pp. xvi+180+16 plates. (London: Edward Arnold and Co., 1927.) 10s 6d. net.

Mr. H. J. L. BEADNELL, during his service in the Geological Survey of Egypt, enjoyed the privilege of two years' survey of the mountains of Sinai. In this book he gives an interesting narrative of his experiences and records, his observations on the country and people, and especially on its

geology and physical geography. The country is of popular interest from its connexion with the wanderings of the Children of Israel on their way from Egypt to Palestine, and the author's account indicates that the physical conditions of this region were the same then as now, and that no large body of people could have crossed the mountains of southern Sinai. Moses probably followed a route across the northern plains.

The scientific interest of Sinai depends largely on the light it throws on the nature of the gulfs on either side. According to Dr Ball, of the Egyptian Geological Survey, the Gulf of Suez is a normal valley of erosion and was excavated by a river along the summit of an arch. According to the alternative explanation, the Gulf is a rift valley due to the subsidence of a strip of country between parallel faults; the actual dislocation of the rocks may be seen from passing steamers, but according to Dr. Ball these disturbances are merely landships. Mr Beadnell declares that the evidence that the Gulf of Suez is a fault-made valley is irresistible. His new information also supports the conclusion drawn from W. F. Holland's map of 1869—to which there is no reference in the text—that the angular parallel-sided valleys of Sinaı are also tectonic and are due to the rifting of the country by the earth movements that made the adjacent gulfs.

The photographic illustrations are of especial interest, for they show the topography and structure with almost diagrammatic clearness. An interesting introduction by Dr Hogarth refers to the historic associations and attractions of this country which he describes as looking, when seen from the eastern (fulf, as alluring as a Gustav Doré vision of hell.

A Year among the Persians: Impressions as to the Life, Character, and Thought of the People of Persia, received during Twelve Months' Residence in that Country in the Years 1887-1888. By Edward Granville Browne. With a Memoir by Sir E. Denison Ross. New edition. Pp. xxii +650. (Cambridge: At the University Press, 1926) 25s. net.

SIR DENISON Ross, who contributes a memoir of the author to this volume, points out that it is a remarkable fact that one of the most fascinating and instructive books of travel ever written should have remained out-of-print for a long period of years. Not only did Browne's valuable work cover a very interesting and important period in the political relations of East and West, as well as in the internal history of Persia, but also he covered ground in his journey which is still very little known. Where it is more familiar, a comparison with present-day conditions, especially, for example, in Asiatic Turkey, is highly instructive.

Browne wrote with a peculiar charm, his style was lively, and, thanks to his marvellous memory, always realistic. The fascination which Persia, and its literature and philosophy, held for him ensured a sympathy with his subject which he never fails to pass on to his readers. Sir Denison

Ross's memoir, which is instinct with the intimate touch of a friendship of long standing, is a faithful picture of a personality full of charm, if not without its peculiarities, and a life of disinterested devotion to the advancement of learning. The thanks of the reading public are due to the Cambridge University Press for their re-issue of a notable and enduring work in a form which is as handsome as it deserves.

(1) Myth in Primitive Psychology By Dr. Bronslaw Malinowski. (Psyche Miniatures: General Series, No. 6) Pp 128 2s 6d. net (2) Fee, Fi, Fo, Fum: or, The Giants in England. By H J. Massingham. (Psyche Miniatures: General Series, No. 5.) Pp 175+4 plates 2s. 6d. net (London Kegan Paul and Co, Ltd., 1926.)

Of these two volumes in this attractively got up little series, Dr Malinowski's contribution is written on lines with which what may be called his 'occasional' writings have made us familiar. It is his method to take some aspect of primitive culture—magic, jurisprudence, or, as on this occasion, myth—and, instead of dealing with it in vacuo, putting it in its context as a live element in the everyday life of primitive man as he himself has known him. In this case he shows what the legend, tradition, or story means to the native of the Trobriands by telling us not only of the matter with which it deals, but also of the manner it is told, the occasion, and by whom. It is, as he says, a reality lived, a hard-worked active force, a pragmatic charter of primitive faith and moral wisdom.

Mr Massingham, on the other hand, belongs to another school and deals with matter that is no longer alive except as the stuff from which theory is made. His giants and dragons carved in the English hill-sides with their traditions and the stories of Arthur, the heroes of the Mabinogion and of Merlin, are the relics of a forgotten age which has to be painfully pieced together in a process of reconstruction. The author being a whole-hearted 'diffusionist,' this reconstruction is based on an interpretation of the material in terms of the 'megalithic culture' and the 'children of the sun' and their derivation from Egypt.

Naturalist's Guide to the Americas. Prepared by the Committee on the Preservation of Natural Conditions of the Ecological Society of America, with assistance from numerous Organisations and Individuals. Assembled and edited by the Chairman, Victor E. Shelford. Pp. xv+761+16 plates. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 45s. net.

This important volume, which indicates the strength of the movement towards the ecological study of the problems of biology in America, will be an invaluable tool in the establishing of Nature reserves from the Amazon to the Arctic Circle. As a result of many years' labour, an enthusiastic band of scientific workers has catalogued all preserved and preservable areas in North America in which natural conditions persist, the ultimate

object being the reservation of all such areas in order that there, so far as possible, the primitive balance of Nature may be maintained. preliminary study indicates, for each of the United States and Canadian provinces, the leading physical features, meteorological conditions, biological zones, summarises the associated flora and fauna, and mentions the areas suitable for Nature reserves. An introductory section discusses from many points of view the uses, values, and management of natural areas, and an effort is made to trace the original biota of North America. Ecological study demands a much more intensive investigation than could be compassed in this extensive monograph, but it sets the framework within which the future worker must build in detail.

Ancient Persia and Iranian Civilisation. By Clément Huart Translated by M. R. Dobie. (The History of Civilisation Series.) Pp xix + 249 + 4 plates (London Kegan Paul and Co, Ltd.; New York Alfred A. Knopf, 1927.) 12s. 6d. net.

MR HUART'S book on ancient Persia contains a very good account of the cultural history of old A vivid picture of the country, and an account of the scripts in which Persian texts have been written, is followed by the history of the three great dynasties, the Achæmenids, Arsacids, and the Sassanids. The real value of the book consists in the excellent analyses of the cultural data referring to each epoch; the social organisation, the religious cults and beliefs, and the artistic productions. The powerful character sketches of the various monarchs and heroes, starting with the legendary Cyrus, receive new life from the cultural background in which they are set. The author makes us feel the scenery, through his descriptions drawn from personal experience and by the many pictures which enliven the book The chronological table and bibliography add to the value of the book, while the excellent index facilitates its use for reference.

Prehistoric Man. Written and Illustrated by Keith Henderson. (The Simple Guide Series.) Pp xv+276. (London: Chatto and Windus, 1927) 7s. 6d net.

As a stimulating introduction to prehistoric man, his haunts, habits, and arts of life, this volume in "The Simple Guide Series" will prove very useful. It is written vividly and without any surface pedantry though it condenses a good deal of information into a small space. It will succeed in sweeping from the picture of our stone age ancestors some of the dry dust with which the learning of specialists, as well as the centuries, have covered it. It leads us from lemurs, monkeys, and apes up to the man of the bronze age. Needless to say, no specialist in prehistory will completely agree with any other author's conclusions, whether these be put in popular or learned language, but, on the whole, Mr. Henderson succeeds in giving a fair and wellbalanced summary of the sound and established results of modern prehistoric science.

### Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

### Experiments on Sex in Rust Fungi.

The phenomenon of heterothallism (the separation of sex in different individuals) is known to occur in the Phycomycetes (Mucor), in the Ascomycetes (Ascobolus, Penicillium), in a large number of Hymenomycetes (mushrooms and toadstools), and in the Smut fungi. Therefore the question arises: Does heterothallism occur in the Rust fungi? An attempt to solve this problem, which is of considerable theoretical and perhaps practical interest, has been made by the author by sowing the sporidia of Puccinia helianthi on leaves of young Sunflower plants and observing whether or not aecia are produced: (1) when a single sporidium is sown by itself, and (2) when two sporidia are sown close together.

Sporidia produced on promycelia developed by teleutospores attached to old dead Sunflower leaves were allowed to fall on to the green leaves of young Sunflower plants in such a way that, as a rule, they settled at some distance apart but so that, sometimes, two sporidia settled close to one another. The sporidia were not actually seen on a leaf after they had settled there. When a sporidium infects a leaf, the pustule at its first appearance is a tiny reddish dot no larger than the dot of an i in this letter. Altogether more than 1200 monosporidial and about 200 bisporidial pustules have been under observation.

The facts observed during the investigation upon Puccinia helianthi may be thus summarised.

A. Within two weeks the following happens, and usually within three weeks nothing more happens:

1. Each isolated pustule derived from a monosportial infection usually becomes 0.6–1.2 cm. in diameter and develops pycnia which excrete nectar, but it does not give rise to any aecia (Fig. I, pustule to the left). The pycnia appear about 8 days after the sowing of the sportia.

2. In a compound pustule formed by the coalescence of two simple pustules, each simple pustule owing its origin to a monosporidial infection, when the distance between the two centres of infection is not more than about 1 mm., either: (a) aecia appear in the compound pustule 10-11 days after the sowing of the spores (Fig. 1, pustule to the right), or (b) no aecia appear.

3. When two simple pustules, each derived from a monosporidial infection, arise near to one another, coalesce, and produce aecia: the nearer they are and the sconer they coalesce, the sconer are aecia developed; while the farther apart they are and the later they coalesce, the later are aecia developed.

4. Where in compound pustules, each derived from two monosporidial infections, the centres of infection are not more than 2 mm. apart, the number of compound pustules producing aecia is about 50 per cent. of the whole. This conclusion is based on observations made upon about 175 compound pustules.

B. At the end of three weeks or more rarely less, in respect to pustules both simple and compound which hitherto have not produced any aecia, the following happens:

1. A majority of the pustules (about 60 per cent.) never produce aecia, even when the pustules persist for so long as six weeks.

2. A minority of the pustules (about 40 per cent.)

produce aecia of normal form and colour. In at least some of these aecia the aeciospores are uninucleate, whereas in aecia produced in a compound pustule 10-11 days after the sowing of the sporidia (vide A, 2, above) the aeciospores are all binucleate.

The following theoretical deductions may be drawn

from the series of facts just recorded.

1. Since pycnospores appear on every mycelium of monosporidial origin, it is clear that, if the pycnospores are really nothing but non-functional male gametes (spermatia), Puccinia helianthi is not dioecious. In other words, the monosporidial mycelia of the Sunflower Rust fungus are not of two kinds: (a) male, bearing spermatia, and (b) female, not bearing spermatia.

2. The pycnospores are not functionless male gametes but are simply conidia corresponding to the uninucleate oidia which appear on the monosporous

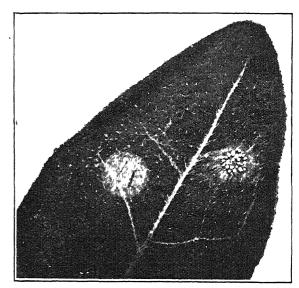


Fig. 1—Underside of a Sunflower leaf which was inoculated on its upper side with sporidia of Puccinu helianthi, photographed twenty-three days after inoculation. To the left, a pustule derived from a monosporidial mycelium showing absence of aceta (it had numerous pycnia on its upper side). To the right, a compound pustule formed by the coalescence of two simple pustules each derived from a monosporidial mycelium. The compound pustule has developed typical aceta. Magnified two and one-half times the natural size

mycelia of such heterothallic Hymenomycetes as Coprinus lagopus, C. niveus, Strophana semiglobata, and Collybia velutipes.

3. The pyenospores produced on (+) monosporidial mycelia are (+) in their sexual nature, while pyenospores produced on (-) monosporidial mycelia are (-) in their sexual nature.

4. The sporidia are unisexual and produce unisexual mycelia. The (+) and (-) monosporidial mycelia, and therefore the (+) and (-) sporidia from which they originate, appear to be about equal in numbers. This suggests that segregation of the (+) and (-) factors takes place in the promycelium during nuclear division in the same manner as it takes place in the basidium of Coprinus Rostrupianus and of C. radians (=C. domesticus).

5. When two sporidia of opposite sex, (+) and (-), are sown close together on a Sunflower leaf so that the pustules arising from the two infections soon coalesce, the two monosporous mycelia come into contact, fuse together, and give rise to normal binucleate aeciospores, each conjugate pair of nuclei formed in the spore-bed consisting of a (+) and of a (-) nucleus

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derived from a (+) and from a (-) mycelium respectively.

6. When two sporidia of the same sex—that is, two (+) sporidia or two (-) sporidia—are sown close together on a Sunflower leaf so that the two pustules arising from the two infections soon coalesce, the two monosporous mycelia come into contact but do not interact sexually, and therefore do not give rise to any

7. The belated aecia, which appear at the end of about three weeks on pustules of monosporidial origin or on pustules of bisporidial origin where presumably the two sporidia are of one and the same sex, probably arise without any hyphal fusions.

8. In any heterothallic Rust fungus that behaves like Puccinia helianthi there is a possibility of two strains of the same species being crossed by means of the union of their monosporidial mycelia within the tissues of one and the same host-plant.

A few experiments have already been made by sowing the sporidia of *Puccinia graminis* on the leaves of the Barberry. The results, so far as they have gone, appear to be similar to those already described for Puccinia helianthi.

In conclusion, I desire to acknowledge valuable assistance derived from consultation with Prof. A. H. Reginald Buller. J. H. CRAIGIE.

The Dominion Rust Research Laboratory, Winnipeg, May 25.

### Eigenvalues and Whittaker's Function.

Among those who are trying to acquire a general acquaintance with Schrodinger's wave-mechanics there must be many who find their mathematical equipment insufficient to follow his first great problem to determine the eigenvalues and eigenfunctions for the hydrogen atom I do not think it is generally realised that Schrodinger's differential equation for this problem is one which is fully treated in a standard text-book, Whittaker and Watson's "Modern Analysis," Chapter xvi. (I quote from the second Analysis," Chapter xvi. (I quote from the second edition) It would seem that advantage may be taken of this to make the treatment easier for English readers. I realise that the following is only a slight redressing of Schrodinger's method; but I think it will be intelligible to some who have been unable to appreciate the original, and that it gives a useful idea of the genesis of eigenvalues.

Having set  $\psi = \chi(r)S_n$ , where  $S_n$  is a spherical harmonic of integral order n, Schrödinger shows that his wave-equation gives:

$$\frac{d^2\chi}{dr^2} + \frac{2}{r}\frac{d\chi}{dr} + \left(\frac{8\pi^2 mE}{h^2} + \frac{8\pi^2 me^2}{h^2r} - \frac{n(n+1)}{r^2}\right)\chi = 0, \quad (1)$$

and he seeks solutions which shall be finite for all

values of 
$$r$$
 including 0 and  $\infty$ .

Writing  $u = r\chi$ , this becomes:
$$\frac{d^2u}{dr^2} + \left(\frac{8\pi^2 mE}{h^2} + \frac{8\pi^2 me^2}{h^2r} - \frac{n(n+1)}{r^2}\right)u = 0.$$

Change the unit of r by writing

$$r_1 = r \sqrt{\left(\frac{-32\pi^2 mE}{h^2}\right)}.$$

The equation then takes the standard form:

$$\frac{d^2u}{dr_1^2} + \left( -\frac{1}{4} + \frac{l}{r_1} + \frac{\frac{1}{4} - (n + \frac{1}{2})^2}{r_1^2} \right) u = 0, \qquad (2)$$

where

$$l = \sqrt{\left(\frac{-2\pi^2 m e^4}{h^2 E}\right)}. \qquad . \qquad . \qquad (3)$$

The general solution of (2) is (W. and W., § 16-31):  $u = AW_{l,n+\frac{1}{2}}(r_1) + BW_{-l,n+\frac{1}{2}}(r_1),$ 

where W is Whittaker's function. It is here sufficient to consider the solution  $u = W_{l,n+1}(r_1)$ . The asymptotic expansion for W (loc cit § 16.3) gives:

We see at once that u vanishes at  $r_1 = \infty$ , and the only danger of divergence is at  $r_1 = 0$ . We notice further that the cases in which

 $n+\frac{1}{2}=l-\frac{1}{2}, l-\frac{2}{2}, l-\frac{5}{2}, \ldots$ 

ie when

$$l = n + 1, \quad n + 2, \quad n + 3, \dots$$
 (5)

present an exceptional feature. For if  $n + \frac{1}{2} = l - p + \frac{1}{2}$ , the last factor in the numerator of  $1/r_1^p$  vanishes, and this zero factor is repeated in every succeeding term. The series thus terminates, and the expansion accordingly becomes exact. The final term in u is then  $e^{-\frac{1}{2}r_i}r_1l^{-p+1}$  or  $e^{-\frac{1}{2}r_i}r_1^{n+1}$ , so that the final term in  $\chi$  is  $e^{-\frac{1}{2}r_i}r_1^{n}$ . Hence  $\chi$  is finite at the origin, and the values (5) are the required eigenvalues. The corresponding energy values -E are then given by (3). The expression (4) gives the eigenfunctions.

A. S. Eddington.

### Use of Carbon Dioxide in a Mercury Interrupter.

It is customary to use coal gas as a dielectric in the mercury interrupter and it has generally been found to be quite satisfactory in action. There are, however, places in the country where coal gas is not available, and the following experiments were undertaken with the view of examining the possibility of employing carbonic acid gas used in connexion with X-ray work carried out in hospitals at such places.

Carbonic acid gas is available in cylinders at many places, and, being an inert gas, it naturally suggests itself as a very useful substitute for coal gas. It is, however, necessary to examine the efficiency of the interrupter using carbonic acid gas by comparing it with that using coal gas and also hydrogen. Since the most important function of the dielectric is to extinguish the flame, it is necessary to examine its action when it is employed in an interrupter in two different ca. stances; in one case, when the primary of the induction coil is connected up straight to the source of electric power which gives just sufficient potential difference in the primary to obtain the desired E M.F. in the secondary, and in the second case, when the primary draws current from the supply main's through a large rheostat which regulates the current in the primary to yield the desired E.M.F. in the secondary.

It is obvious that the two cases are different. In the first case, the sparking inside the interrupter is considerably less than in the second case, where the whole potential difference of the supply mains is

effective in producing the spark at the break.

The experimental work for each gas was consequently divided up into two parts. In the first part the power to the primary was supplied from a potentiometer device connected up to the 230 volts D.C. mains, and in the second, the primary was connected to the mains through a rheostat.

The length of the spark-gap was taken to indicate the magnitude of the voltage generated in the secondary. The current drawn by the primary could be read off from an ammeter placed in series with it (see Fig. 1). The same experiments were repeated with an X-ray tube connected up with the secondary with a milliammeter in series (see Fig. 2).

In the second part of the experiment the primary

and the interrupter were connected up to the main supply of 230 volts and the current was suitably cut down by means of an adjustable rheostat and measured by means of an ammeter (see Fig. 3). The same experiments were then repeated, using an X-ray tube (see Fig. 4).

It can be seen from the results that in either case, The difference between the working of the gas-

when hydrogen or carbonic acid gas is used, the efficiency of the interrupter is greater than when coal gas is used. Hydrogen gives the longest sparkgap, that is, the highest value of the secondary E.M.F. with the smallest potential difference in the primary. mercury-interrupter using coal gas and carbonic acid gas is less in the case when the full 230 volts are allowed to play across the break than when the potential difference at that point is carefully adjusted

These results should prove useful in places where coal gas is not available but where carbonic acid gas can be carried in steel containers.

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Department of Physics, Royal Institute of Science, Bombay.

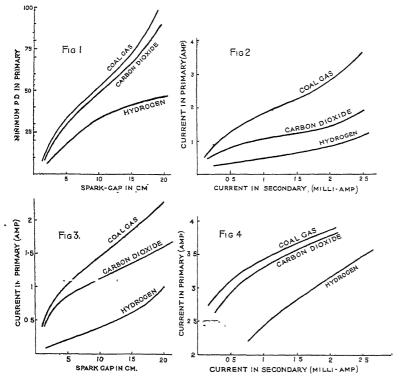
### Biological Fact and Theory.

"I've often thought that headstrong youths Of decent education, Determine all-important truths, With strange precipitation, ("The Periwinkle Girl," W. S. Gilbert's "Bab Ballads.")

> If, instead of attributing to me a certain skill in controversy, Prof. J. S. Dunkerley (July 2, p. 12) had paid my intelligence the greater compliment of reading carefully what I had written, I might have been saved from begging for more space in which to refute what I believe are mistaken ideas. I had hoped that I had so expressed myself that my meaning was quite clear even to the casual reader. As Prof. Dunkerley has missed all my important points, I have apparently failed in his case and may have done so in others. May I give a variant of what is perhaps the most important argument I have used, which I hope will be intelligible to

> The very evidence that favours the hypothesis that units representing Mendelian characters are present in individual chromosomes, is absolutely against the probability of such units representing those characters that are common to all individuals comprised in an indefinite number of successive generations in a large group of organ-The 'Neo-Mendelian theory' isms. assumes that all characters are dependent upon 'genes' and that all genes' are units arranged in regu-

lar order, each in its particular chromosome. The cell phenomena that precede fertilisation, according to presently accepted observations, seem to provide for an alternative distribution of the chromosomes to the daughter cells. As, however, only half the somatic number of whole chromosomes go to each sperm or mature ovum, only a proportion of the organisms of the next generation can contain any given paternal or maternal chromosome. This agrees with the Mendelian breeding experiments, but is incompatible with the reappearance of those characters common to all individuals in successive generations, if every character is represented by a unit which has an assigned place in a particular chromosome. The hypothesis that the capacity for reproducing recent variations is conveyed by the chromosomes, while common racial characters are dependent upon something else in the cell, does not appear so utterly incompatible with recorded breeding experiments and cytological observations as the 'Neo-Mendelian theory' of 'genes.' The Mendelian characters are probably recent variations and may be represented in the chromosomes; racial characters



to the minimum to yield the required E.M.F. in the secondary as indicated by the length of the spark-gap. The curve for carbonic acid gas being lower than the curve for coal gas, it is also clear that it would be more economical to use carbonic acid gas, since to obtain equal E.M.F.'s in the secondary, less electric power is required in the primary.

There is next the question of safety in handling the Carbonic acid gas, being heavier than air, is capable of easily displacing the air from the interrupter, and the fact that the interrupter is full of the gas can be easily tested. The gas itself is of course harmless.

Further points in connexion with this gas are that it has no action on the electrodes and the gas remains unaltered after long use. In order to ascertain that the gas remained unaffected by constant sparkings inside the interrupter, the gas was tested after half an hour's continuous run. Samples of the gas-filling were drawn off from the interrupter, and on analysing them it was found that the gas had not undergone any appreciable change. The electrodes also were not affected.

cannot. If Prof. Dunkerley will again read my previous letters to Nature (Jan. 29 and June 4) he will realise that the 'exceptions' to the 'Neo-Mendelian' views of the functions of the chromosomes were given in the hope of elucidating this interpretation of generally accepted observations, and not with the incomprehensible objective which he attributes to me.

Prof. Dunkerley writes: "The transmission of paternal characters by the spermatozoon is not denied by Dr. Walker, and if he doubts the transmission of these characters in some way through the chromatin material of the male sperm cell, there is very little left in the sperm." This is an example of those loose methods of thought and expression which have led to much misunderstanding of biological problems. What are "the paternal characters"? Are those peculiar to the male parent only implied? Godlewski fertilised enucleated eggs of sea-urchins with the sperms of crinoids, and these developed into gastrulæ possessing only maternal characters, though apparently all the chromosomes present were of paternal origin (Archiv fur Entwicklungsmechanik, Bd. 20; 1906). There are records of many other experiments bearing upon this point (Driesch, H., Arch. f. Entwick., Bd. 16; 1903. Boveri, Th., ibid. Loeb, J., Arch. f. d. gesam. Physiol., Bd. 99; 1903. Bataillon, E., Arch. d. Zool. Expér., Tom. 6; 1910).

I do doubt the transmission of paternal or any other characters in any way by the chromatin of any cell, even including the "male sperm cell," whatever that may be. So long ago as 1907 ("Essentials of Cytology") I pointed out that in all probability the chromatin is merely a secretion of the linin, and that if there are permanent and individual constituents of the cell handed on from one generation to another, they are to be found in the linin and not in the chromatin. Doubtless the little regular rows of chromatin granules of the cytological preparation are tempting to the 'Neo-Mendelian,' but the evidence against their permanent nature is strong.

I fail to see the point of the remark as to the proportion of the sperm left when the chromatin is eliminated.

Having admitted the difficulty of imagining all or half the potentialities "for the development of an animal" being contained in the "microscopic spermatozoon," Prof. Dunkerley goes on: "Then is it much more difficult to believe that these potentialities are arranged in some sort of order in the individual chromosomes?"

"I can't believe that!" said Alice.

"Can't you?" the Queen said in a pitying tone.
"Try again: draw a long breath, and shut your eyes."... "I dare say you haven't had much practice," said the Queen. "When I was your age, I always did it for half an hour a day. Why, sometimes I've believed as many as six impossible things before breakfast." ("Through the Looking-Glass," Lewis Carroll. London: Macmillan and Co., 1873.)

University of Liverpool, July 3.

## On X-ray Diffraction Patterns from Liquids and Colloidal Gels.

On account of the present great interest in the interpretation of X-ray patterns for amorphous substances (broad haloes) it seems desirable to present in a preliminary way a few of the observations made in the present writer's laboratory. These tend to show that very important information of practical bearing can be obtained on rubber and its substitutes, introcellulose, gelatine, linseed oil, china wood oil, resins,

varmshes, etc In all cases the films have been measured photometrically so that on the curves the exact centres of the broad bands are easily located.

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For unstretched rubber latex films the spacings calculated by the Ehrenfest formula  $(a = 7.72 \, \lambda/4\pi)$  $\sin \theta$ , where  $2\theta$  is the diffraction angle) from the two principal rings (second order faint rings appear in addition) are 6.03 Å.U. and 14 76 Å.U., in fair agreement with Hauser and Rosbaud (Kautschuk, Jan. 1927, p. 17). When, however, the rubber is very carefully purified by a process of fractional solution and evacuation to constant weight, the spacings are 5.97 Å.U. and 11 15 Å.U., a profound change in the inner ring. Intermediate values up to 14 76 Å.U. have been observed with solvent swelling. On account of the excellent proof by Zernicke and Prins (Zeit Physik, 41, 184; 1927) that the broad rings are indicative of the natural distance of nearest approach of molecules, the classical Bragg formula  $n\lambda = 2d \sin \theta$  seems preferable to the Ehrenfest expression, which was derived for regular spacing of atoms within molecules.

With nitrocellulose of the same composition the following quantitative results are typical for the spacings of the inner and outer rings respectively

calculated by the Bragg formula:

	Fresh.	Aged (light).	(heat).
Untreated, dry	$\begin{cases} 7 \ 18 \ \text{Å U.} \\ 4 \ 02 \end{cases}$	{7 17 Å.U. 4 05	{6 98 Å.U. 3.92
Dry, residual solvent present	${9\ 30} \atop {4\ 47}$	${9\ 32} \ 4\ 47$	${786} \ 431$
Oil softener added	${734} \ 4.31$	$\{\overline{\frac{1}{439}}$	$\{\frac{1}{439}$

The swelling or combination of molecules with solvent or oil has a much greater effect than aging, even though the film may become very brittle.

Contrary to the results of Katz (Zevt. physik. Chem., 125, 321; 1927), distinct though usually small differences in spacings are observed with china wood oil and linseed oil during polymerisation and drying. The following remarkable results on china wood oil were obtained by careful measurement of the photometric curves; they are expressed as percentage change related to the spacings of the raw liquid oil calculated by the Bragg formula:

The prepared liquid in this case consisted of china wood oil heated with Venice turpentine and thinned with pure turpentine. The film dries with a crystalline finish, which is, however, only a pseudo-crystalline wrinkled skin. The increase in spacings (decrease in ring diameters) in every case, including drying, over those of the raw oil is remarkable. Combination with solvent molecules and polymerisation are both definitely indicated. No indication has been found in these patterns of long spacings such as are obtained with solid carbon chain compounds, and such as have been observed for liquid primary normal alcohols by Stewart and Morrow (Proc. Nat. Acad. Sci., 13, 222; 1927). It is possible that diffraction rings corresponding to these long spacings may be so close to the central direct-beam trace on the photographic films that they are not defined. This is particularly true where molybdenum Karays have been used instead of rays from a copper target.

Similar results have been obtained with cumar, resins, varnishes, etc. In all cases it is clear that the 'amorphous' ring diagrams may yield very important

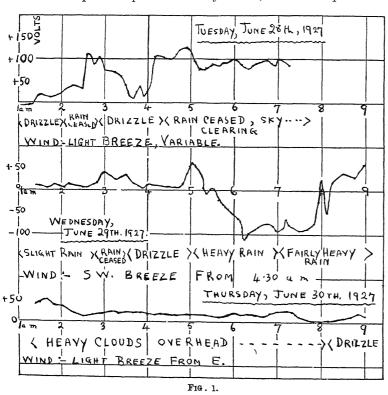
theoretical and practical results in terms of fundamental space array of molecules or aggregates acting as units, polymerisation, the swelling of gels, and changes during aging. X-ray science has apparently reached the stage wherein it may analyse all matter in any form whatsoever.

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### Potentials during the Solar Eclipse.

OWING to adverse weather conditions we were unable to take any photographs of the solar eclipse at Bangor. Certain other observations which were made may be of interest. A thermometer mounted on a stand in the open and viewed through a telescope recorded a drop in temperature of only 0° 5 C., the



actual temperature at the time of totality being  $8^{\circ}\text{-}5~\mathrm{C}.$ 

Readings were taken by the water-drop method of the variation of the potential at a point 215 cm. above the ground before, during, and after the eclipse. The potentials recorded on June 28, 29, and 30 are shown in the accompanying diagram (Fig. 1). It will be noticed that during the eclipse there was a change from a positive to a negative potential, this change being probably due to the heavy rain which fell at the time.

The darkness and fall of temperature during totality were not so marked as they would have been had there been no cloud, and the whole phenomenon was disappointing in this part of the country.

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No. 3012, Vol. 1201

## Series in the First Spark Spectrum of Tin.

Following the work of one of the authors on regularities in the spark spectrum of tin (Sn III, Proc. Phy. Soc., 39, 161; 1927; and Sn IV, in the course of publication), the spectrum of the element in the singly-ionised stage (Sn II) has been investigated.

According to the theory of spectra recently developed by Hund, the first spark spectrum of tin must arise from transitions of one electron successively through the  $O_2$ ,  $P_1$ ,  $O_3$ ,  $P_2$ ,  $Q_1$ ,  $Q_4$ ... shells which result respectively in the usual doublet terms in the order of value,  $1^2P$ ,  $1^2S$ ,  $1^2D$ ,  $2^2P$ ,  $2^2S$ ,  $1^2F$ , etc. All these terms have been found, the largest being  $1^2P_1 = 117684$ , giving the second ionisation potential of tin to be about  $14\cdot 5$  volts. Besides these, the configuration of

Besides these, the configuration of one  $O_1$  and two  $O_2$  electrons gives  ${}^4\bar{P}, a^2D, {}^2P, a^2S$  terms. Combination pairs between this  $a^2D$  term (found to be identical with the  $x_{12}$  terms mentioned in the paper referred to above) and the regular  ${}^2P$  and  ${}^2F$  terms are detected, the latter forming a characteristic series, very prominently seen in the spark spectrum of the element, and there is probably an indication of the existence of the  ${}^4\bar{P}$  term also. As a result of the analysis, about thirty lines of the first spark spectrum of the element have been classified, which include a large number of the strong lines observed in the ordinary spark and the vacuum arc in the visible and the fluorite region.

The first doublet P separation is found to be 4247 cm.<sup>-1</sup> which is in agreement with the value inferred from the probable limiting difference  $\omega^3 P_1 - \omega^3 P_2$  of the arc spectrum of tim. The second separation  $2^2 P_1 - 2^2 P_2 = 886 \cdot 2$  and the second principal pair  $1^2 S - 2^2 P_{12}$ , with the aid of the relativity doublet laws, have led to the two following pairs in the spectrum of Sb III (which is under investigation by us). These pairs probably form the con-

pairs probably form the consecutive members of the second sharp series of the spectrum.

λ.	Int.	ν.	$\triangle \nu_*$
4591·89 4265·089	(5) (6)	21771.5 $234396$	1668-1
4693·09 4352·25	(5) (6)	$\begin{array}{c} 21302\ 0 \\ 22970\ 2 \end{array}$	1668-2

In general features the first spark spectrum of tin is found to resemble closely the spectrum of Si II, analysed by Fowler. Details of the analysis will be published shortly.

> A. L. NARAYAN. K. R. RAO.

Vizianagram, May 29.

### The Leeds Meeting of the British Association.

LOCAL ARRANGEMENTS.

AFTER an interval of thirty-seven years the British Association is again meeting at Leeds The City and University joined in a cordial invitation to the Association, and are working hard to live up to Yorkshire traditions of hospitality in connexion with the meeting The president, Sir Arthur Keith, has already made himself known to many citizens of Leeds when he addressed the Luncheon Club earlier in this year upon the subject of science and civilisation. His visit was much appreciated and increased the interest of many citizens in the coming visit of the great scientific Association over which he will preside

As in 1890, the Reception Rooms are in the Town Hall, which is centrally placed for all the stations upon the main railway lines serving Leeds. A special room will be put aside in the Town Hall for the convenience of members wishing to obtain information or tickets for the various excursions The ample accommodation available permits of the usual facilities for writing-rooms, refreshments, post office, etc. As usual, the Meteorological Office will have an exhibit, whilst a new feature will be a room put aside for the purpose of demonstrations by the British Broadcasting Corporation. In the crypt of the Town Hall an exhibition of scientific apparatus is being arranged, to which a number of well-known apparatus firms are contributing The general officers will occupy rooms in the City Education Offices, which face the Town Hall across Calverley Street. Meetings of the general committee and council will probably also be held in the Education Offices.

The secretariat will be at the Metropole Hotel, which is within two minutes of the Town Hall and of the Majestic Cinema, a fine building recently erected in the city, in which the presidential address will be delivered. The Majestic fronts upon City Square, in which Priestley's statue will be found, as also the Unitarian chapel of which he was at one time minister. The University is distant a short ride by tram along the Headingley route from City Square. All the meeting-rooms of the sections will be found either along this route or at the University. The meeting-rooms of the sections fall naturally into two groups: at the University will be found Sections A (Mathematical and Physical Sciences), B (Chemistry), C (Geology), D (Zoology), K (Forestry Sub-section), and M (Agriculture), whilst K (Botany) and G (Engineering) are in the immediate neighbourhood in the Trinity Congregational and Emmanuel Church School-rooms. Many of these sections will also have rooms in various University buildings for scientific exhibits, whilst luncheon and tea can be obtained at the University Refectory, at the Staff House and De Grey Road, or in the large Physics Laboratory. In the Engineering Lecture Theatre at the University several meetings are also to be held for the discussion of scientific problems connected with the textile industries. Of the other sections, I (Physiology) naturally finds

its home at the Medical School, whilst H (Anthropology) is appropriately housed in the Philosophical Hall, the headquarters of the long-established Leeds Philosophical and Literary Society.

These sections, as also E (Geography) in the Alexandra Hall, F (Economics) in the Y.W.C.A., J (Psychology) in the Masonic Hall, and L (Education) in the Albert Hall, are all close to the Reception Rooms and will amply be catered for, as regards lunch and tea, by the Reception Room and many restaurants in the shopping and Hotel quarters of the City in the immediate neighbourhood.

Many of the visitors will be staying in University hostels, or hostels of the Training College at Beckett's Park. Some of the University hostels are close to the University, and visitors staying at Lyddon Hall, College Hall, or University Hall will be able to lunch in hostel if they desire

The president himself will be the guest of the City in the Judge's Lodgings, which are conveniently situated with regard to the meeting-places of the Association, all of which are within a very short

distance of one another.

Leeds makes an excellent centre for those who wish to make themselves acquainted with the beauty spots of Yorkshire, and in consequence the local committee has arranged a wide field of excursions that should meet all needs. important abbeys in Yorkshire are to be visited under the leadership of well-known archæologists. Mr. Peers, of H.M Office of Works, will act as the leader of the excursion to Rievaulx and Byland Abbeys, while Prof. Hamilton Thompson will act in a similar capacity to the excursion to Bolton Abbey and Skipton Castle. The limestone country around Ingleborough is also to be visited, and opportunities for drives into Nidderdale and Wensleydale will be given. A local committee has been formed at York and Harrogate, and visitors to either of these places are assured of a hearty and interesting welcome. Probably a unique excursion is that to Gaping Ghyll where, thanks to the kind offices of the Yorkshire Ramblers' Club, a limited number of members will make the descent. In addition there will be a number of visits to works and factories in, and near, Leeds, and two visits to the Mines Rescue Station at Wakefield are included in the programme.

The Lord Mayor and Lady Mayoress are to give a reception to all members of the British Association in the Art Gallery on Thursday, Sept. 1, at 8 P.M., and on Tuesday evening, Sept. 6, the University of Leeds will entertain members at the University, when most of the scientific and technological

departments will be exhibiting.

Garden parties are to be given by Major Fawkes, of Farnley Hall, on Friday, Sept. 2—an exceptional opportunity for members to inspect the fine collection of Turner pictures that he possesses—and by Col. C. H. Tetley of Foxhill, the Pro-Chancellor of the University. On Saturday, Sept. 3, Lady

Lawson Tancred will entertain at tea those members who take the excursion to Aldborough. who are interested in textiles are invited by the British Research Association for the Woollen and Worsted Industries to visit its laboratories at Torridon on Thursday, Sept 1

Through the courtesy of the Leeds Choral Union a concert will be given in the Town Hall on Sunday, Sept. 4, at 8.15 P.M., and the items on the programme include Grieg's "Concerto," Elgar's The Dream of Gerontius," and Parry's "Blest Pair of Sirens "

On Tuesday morning, Sept 6, at 12 noon, a Congregation of the University will be held in the Great Hall, at which a number of honorary degrees will be conferred.

### Science and Industry in Italy.

THE opening on May 28, by the King of Italy, of the Volta Centenary Exhibition at Como is a reminder to the world of the progress of



Fig. 1.—Copy of bust of Volta by Gio. Battista Comolli.

science and industry in Italy. The land of great poets and painters, of famous churches and uni-

versities, Italy was one of the first countries to witness the rebirth of scientific studies, and from the days of Leonardo da Vinci the lamp of science has been kept burning. Just as the labours of Galileo and Torricelli, of Boscovitch, Vesalius, and Malpighi, of Avogadro, Cannizzaro, Secchi, and Schiaparelli have added lustre to her schools, so has the work of a long line of eminent hydraulic engineers engaged in harnessing the rivers of the Alps and Apennines made Italy famous as a nation of constructors.

Inaugurated to commemorate the centenary of the death of Volta, who passed away at Como on

its patrons Signor Benito Mussolini and Senatore Gughelmo Marconi. The site of the Exhibition is the spacious eighteenth-century mansion, Villa Olma, once the property of a great Milanese nobleman but now owned by the Commune of Como. It is in the fine ballroom of the villa, with its two-storied balconies, that many of the congresses will be held. In the villa itself is also displayed the collection of instruments illustrating Volta's own apparatus and his important in-

In 1899 another exhibition was held to celebrate the centenary of the discovery of the voltaic pile. but, as recorded in our columns at the time, on July 13 of that year practically the whole of the exhibition was destroyed by fire, and nearly all of the precious Volta relics perished—a loss to science only comparable with the destruction of Priestley's books, manuscripts, and apparatus in the Birmingham riots of 1791. Before the fire, however, photographs had been taken of the apparatus, and from these it has been possible to make replicas. The most interesting of these, perhaps, are the copies of the voltaic piles used by Volta in his demonstration in Paris when Napoleon attended a sitting of the National Institute, and the early forms of battery developed from the 'couronne des tasses.' As is generally known, Volta's invention of the pile was described in a letter written to Sir Joseph Banks on Mar. 20, 1800, from Como, and it was the information contained in the first part of the letter which led Carlisle and Nicholson to the experiment on the decomposition of water by the electric current.

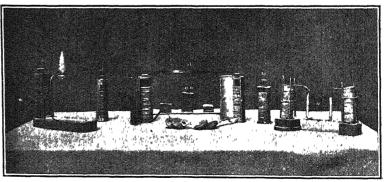


Fig. 2.—Examples of Volta's experimental piles

In the grounds of the Villa, temporary buildings have been erected, and in these and the house Mar. 5, 1827, the Centenary Exhibition has among | itself are displayed the various exhibits. The two most important sections of the exhibition are the International Exhibition of Electrical Communication and the National Electric Water Power Exhibition. To the former Senatore Marconi has lent a valuable collection of apparatus, some of which was used in his earliest experiments, together with a number of transmitting and

receiving instruments which were used in the days before the advent of the thermionic valve. Among the apparatus is a copy of that employed by Senatore Marconi in his experiments at his father's house at Bologna in 1895. No fewer than thirty-five states, including Great Britain, have sent exhibits, while the Italian Government have installed a short-wave radio station of 25 kw. power which will be working.

Of the work of the Italian nation in the extension of hydroelectric power generation and

transmission, much information is given by charts, photographs, etc., supplementing the review given by Prof. Emirico Vismara and others at the World Power Conference held at Wembley in 1924. Italy has taken a leading part in hydro-electric power development, and Prof Vismara recalled

rainfall, but with no coalfields, hydro-electric plants are a necessity to Italy, and these are now linked together so as to cover almost completely large portions of the country. It is an interesting economic feature, however, that with the development of electric power from water the importation of coal tends to increase and not decrease.

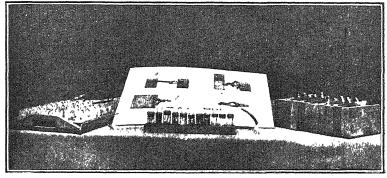


Fig 3 -Early voltage batteries and experiments on frogs' legs

During the course of the Exhibition, which will be open from May until October, many congresses will be held, amongst which the most important will be the Congress of Physics and the International Congress of Electrotechnics Distinguished scientific workers, many of them of international

repute, from Austria, Canada, Germany. Denmark, France, Great Britain, Holland, Italy, Russia, Spain, Sweden, Switzerland, and the United States, will attend the Congress of Physics. The universities of Great Britain will be represented by Dr F. Wil be represented by Dr F. W. Aston, Prof. W. L. Bragg, Prof. A. S. Eddington, Sir Ernest Rutherford, Sir J. J. Thomson, Dr. J A. Fleming, and Prof. O. W. Richardson, Canada by Prof. J C. McLennan; and India by Prof. M. Saka, At the same by Prof. M. Saha. At the conclusion of the Congresses the delegates will be conducted to Venice, Florence, and Rome, as the guests of the Italian Government, and the great national commemoration of Volta's centenary will take place at Rome in the Capitol on Sept. 19. The entire arrangements appear to have been planned on a scale

worthy of the occasion, and worthy of the place science should take in the daily life of every progressive nation. Centenary celebrations nowadays follow each other with increasing rapidity, but the Volta centenary commemoration is one which does homage to an outstanding figure in Italian science, whose discoveries have led directly to the applications of science by which Italy has become a great industrial nation.

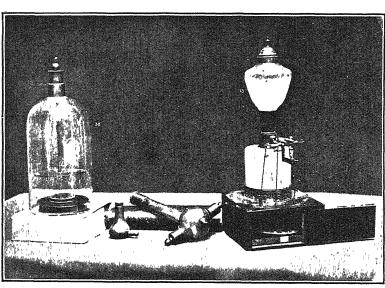


FIG. 4.—Volta's hydrogen lamp, electric pistol, and apparatus to test theory of hall formation

how, on the completion of the transmission line from Tivoli to Rome, 25 kilometers at 5000 volts, in July 1892, Kelvin, Ayrton, Preece, Crookes, Swan, Crompton, and others telegraphed: "The English Electricians send greetings to Electricians of Italy on completion of splendid enterprise of Tivoli, and wish them every success." Another notable achievement was the line from Paderno to Milan, carrying current at 13,000 volts. With her great mountain chains, with an abundant

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# Excavations at Ur of the Chaldees, 1926-1927. By C. LEONARD WOOLLEY.

THE excavations started last year on Oct 28 and were closed down on Feb. 19 With the exception of Father Burrows, who replaced Dr Legrain as epigraphist, my staff was the same as in the former season, Mrs Keeling being responsible for the drawings, Mr Whitburn for the architectural side, and Mr. Mallowan acting as general archæological assistant; as foreman I had again Hamoudi from Jerablus, while his two sons were engaged, one as photographer, one as junior The number of workmen employed was smaller than usual, in view of the nature of our programme, and averaged about 130 The work fell into two distinct parts the excavation of building sites, principally the houses of the Larsa period, and the examination of a large prehistoric cemetery.

The house site lay just outside the sacred Temenos, against its south-west wall. Here we cleared parts of five streets, laying bare the remains, for the most part very well preserved, of fifteen houses, enough to give us a fair idea of town-planning in the period between 2100 and 1900 BC. Contrary to what excavations on other sites of later date had led us to expect, the houses proved to be remarkably well-built structures in burnt and crude brick, standing two storeys high, with an average for a moderate-sized house of twelve rooms. Of course the exigencies of ground space and of the owner's means introduced all sorts of variations, but throughout there was recognisable one general type. The house was built round a central courtyard on to which opened all the rooms, round this ran a wooden gallery reached by a staircase of brick below and of wood for the upper flight, giving access to the chambers of the top floor; the house roof extended over the gallery, sloping slightly inwards, and left in the centre a comparatively small opening which served as a light-well for the ground-floor: gutters round the edge of the opening led the rain water from the roof into a drain in the middle of the brick-paved court. It was possible to identify some of the rooms. The front door led into a small lobby communicating with the court, facing the entrance was the reception-room, on one side the kitchen, and below the stairs the lavatory, with a drain exactly like that of a modern Arab latrine. Altogether the arrangement and appearance of the house was precisely what one finds in the better quarters of Basra or Baghdad at the present day

We knew already that it was the custom to bury the dead under the floors of the rooms in which they had lived; this year we found an extension of the custom in that some of the houses were provided with a regular funerary chapel designed as part of the original building; the chapel was a long chamber having at one end a

 $^{\rm 1}$  From a discourse delivered at the Royal Institution on Friday, June 10.

the exa

brick altar and a column of brickwork (the meaning of this is uncertain), and below the pavement of the 'nave' there was a vaulted brick tomb which acted as a family vault, some containing as many as ten bodies interred at different times. In one case, instead of the tomb there were grouped round the altar clay bowls and coffins containing the bodies of infants, more than thirty in number; it would look as if the chapel were dedicated to some goddess who was a patroness of children.

One of the most important discoveries made in the houses was that of a fallen brick arch in one of the doorways This takes back the history of the arch as a feature of domestic architecture by several hundred years and enables us to work out reconstructions of buildings of this period (c 2100 BC) in a manner for which there was before no justification in fact. We can now be sure that the arch and the vault were regularly employed in temples, and it is not unreasonable to suppose, in view of certain peculiarities of ground-plan, that in the next great building period, that of 1400 B.C, the dome also was used. The chief 'finds' made in the houses were of inscribed tablets Many of these were ordinary business documents, but we have, besides a few religious texts, lists of the pious foundations of kings, grammatical texts and syllabaries, and mathematical tablets with such things as tables of square and cube roots, exercises in land mensuration, etc.

Work on building sites other than that of the Larsa houses threw much new light on the topography of the sacred Temenos, filling up what had been blanks on our general plan and leading to the identification of the great temple of the moon god Nannar in the time of Nebuchadnezzar; the discovery of a remarkable building set up by Sin-idinnam, king of Larsa (c. 2000 B.C.) about a mile to the east of the Temenos enclosure showed how widely scattered were the public buildings of the city and how much work remains to be done even after the excavation of the Temenos itself is complete. Further digging beneath the floors of the temple E-nun-makh, first excavated in 1922, brought to light new historical information and. amongst other objects, a set of ivory toilet instruments of fine Phœnician work and an ivory plaque bearing a remarkable Phænician inscription.

The second part of our season was spent in the examination of a cemetery lying at the southeast end of the Temenos and inside its later walls. The graves, distinguished by their levels and contents, belonged to three periods, the uppermost to 2800–2600 B.C., the next to about 3100 B.C., the earliest to some five hundred years before that. The upper levels were dated by inscribed cylinder seals, two graves of the first series belonging to members of the household of the daughter of king Sargon of Akkad, while from the second series came the seal of the wife of Mesannipadda, first King of the First Dynasty of Ur; the date of the

lowest graves was deduced from the very great amount of deposit separating them from the middle series and by the difference of script on the inscribed objects, this being semi-pictographic instead of fully developed cuneiform. In the lowest stratum the bodies are sometimes partly burnt, evidently a survival of an older practice of cremation, all signs of this disappear in the upper levels. The normal type of grave is a mere hole in the ground lined with matting in which the body was placed wrapped in a mat, the offerings were grouped about it and the whole covered with a second layer of matting before the earth was replaced Later, wickerwork coffins might take the place of the simple mats, and two or three wooden coffins were found. From the earliest times clay coffins were occasionally used, and these became more common as time went on, it is curious that the clay coffins, which would seem to be the more costly form of burial, were in fact the poorest in their furniture.

The objects from the graves were such as no previous excavations in Mesopotamia have produced, and it was noteworthy that in richness, in quality, and in technique they were better in proportion as they went back earlier in time. Though we have touched the oldest dateable strata yet found (I except that of the painted pottery, about which virtually nothing is known). it is clear that we have to deal with a civilisation which if not already decadent had at least been in existence for many centuries.

Most striking are the gold objects. The wealth of precious metal found in the graves is proof of the prosperity of the age, but also it is in these things that we have best evidence of its high state of culture, for the gold was the material on which the workman lavished most skill and it alone has suffered no decay. Not only beads, pendants, and personal ornaments are of gold, but we find even tools and weapons of gold or of electrum; these must have been ceremonial rather than for practical use, but they reproduce the forms of implements in copper and in silver Far the finest is a dagger of gold and lapis lazuli in a sheath elaborately decorated with filigree, besides this we have a spear-head, an adze, and two chisels of electrum. the handles of such weapons were of wood covered with gesso painted red and bound with thin gold Toilet utensils were made of the same metal—one set is in a finely decorated case—as well as in silver and copper; bowls, vases, and lamps were sometimes of silver, and one silver bowl is beautifully fluted and engraved

Engraving on shell was fairly common a set of plaques thus worked with animal subjects and framed in lapis lazuli and red stone was the most attractive, while a gaming-board with inlaid geometrical designs is perhaps of greater interest though of less artistic merit, a larger plaque showing a priest at sacrifice is an unusually fine example of the same technique. Ostrich eggs and sea-shells were sometimes encrusted with lapis, mother-of-pearl, and red paste. Stone vases in 'alabaster,' steatite, and limestone were very numerous, copper was astonishingly abundant, and we found one instrument of iron, this from a grave in the lowest stratum. The beads are of lapis and carnelian, very well cut and polished, and were set with others of silver and gold, the latter being often made with a thin plating over copper.

Only the pottery is disappointing in its quality. Sculpture is represented by some curious figures in unbaked clay and by a fragmentary but most important relief showing an empty chariot drawn by lions being led in procession, perhaps in the funeral procession of a king Lastly, we have recovered a great number of engraved cylinder seals invaluable for the study of early art forms. Altogether the season's work has produced a mass of material, much of it entirely novel, the importance of which for the early history of Mesopotamia it would be difficult to exaggerate I am glad to say that there is every reason to believe that discoveries of no less importance await us next winter.

### Obituary.

WE regret to announce the following deaths:

Mr. Charles Ford, I.S.O., Superintendent of the Botanical and Afforestation Department, Hong-kong, from 1871 until 1902, on July 14, aged eighty-three years.

Prof. Chas. W. Hargitt, research professor of zoology in Syracuse University and vice-president of Section F of the American Association in 1903, distinguished for his work on the coelenterates, on June 11, aged

seventy-five years.

Prof. A. Kossel, emeritus professor of physiology in the University of Heidelberg and editor of the Zeitschrift für physiologische Chemie, who was Nobel laureate for physiology in 1910, on July 6, aged

seventy-three years. Mr. John Macleod, I.S.O., formerly professor of mathematics at King's College, Nova Scotia, and the author of numerous original theorems in pure

geometry, aged eighty-six years. Mr. Hudson Maxim, inventor and manufacturer of explosives, of Brooklyn, New York, aged seventy-

Prof. M G. Mittag-Leffler, For Mem. R.S., formerly professor of pure mathematics in the University of Stockholm and founder and editor in chief of Acta

Mathematica, aged eighty-one years.

Mr. J. H. Reynolds, formerly Principal of the Municipal School of Technology (now the College of Technology), Manchester, and Director of Higher Education, who was president in 1913-14 of the Association of Technical Institutions, on July 17, aged eighty-five years.

Mr. B. Lewis Rice, C.I.E., formerly Director of Archæological Researches in Mysore and author of "Epigraphia Carnatica," on July 10, aged eighty-nine

Mr. G. B. Sudworth, for more than forty years dendrologist of the United States Forest Service and author of "Check List of Forest Trees of the United States, their Names and Ranges" (1898), on May 10, aged sixty-three years.

Mr. W. S. Valiant, curator of the Geological Museum at Rutgers College, known chiefly for his discovery of Ordovician trilobites in the Utica shales at Rome, New York, on Mar. 27, aged eighty-one years.

### News and Views.

THE Wild Birds Protection Bill is dead, after the second reading had given promise of a safe passage through the House of Commons. In the opinion of those best competent to judge, it was a measure designed to give better protection to British birds than even the old and scattered Acts, which it was to supersede, had done. But it has been killed by slogans devised by well-intentioned but less well-informed propagandists. It was called a "Rare Birds Protection Bill," yet it protected every bird in the country, it was sneered at because it gave different degrees of protection to different birds, but so long as some birds are persecuted and some are not, it is reasonable that the degree of protection should vary; it was said that the birds would be better off without the Bill. but the statement betrays lack of knowledge of the operation of the present Acts and the particular points on which experience has proved them to be weakest; it was said that public opinion was against the Bill, on the contrary, the informed public were in favour of the Bill. The death of the Bill is to be regretted by all interested in the effective protection of birds in Great Britain, the more so as its disappearance is due to the blind faith of certain members of Parliament in the propaganda of malcontents.

WICKEN FEN, under the care of the National Trust and its local committee, promises to become one of the most instructive of the natural reserves in Great Britain. It can never possess the grandeur of scenery or of fauna of the wild mountain areas of Scotland. but it has many advantages. It is unredeemed fenland, most of its 600 acres uncultivated and untouched. it contains a typical marsh flora with several rare ingredients and a rich insect fauna nourished upon the plants, and it is near a flourishing school of biology which has detailed experts for the analysis of the various plant and animal groups, with the result that a preliminary survey has almost been completed. It has been found, however, that the cost of keeping the reserve in order has outrun the funds devoted to the purpose, last year by a sum of £268, and the National Trust has launched an appeal for a capital sum of £10,000, the interest of which will be available for the upkeep of the sanctuary. It is also the intention to add 340 acres to the present reserve and "so put the whole property on a sound financial basis "

A NOTICE of the appeal for Wicken Fen which appeared in the *Times* of July 14 contained the statement that, left to itself, the fen flora would decrease by two-thirds of the present number, and that the fauna would shrink from 6000 species to fewer than 2000. In Nature's care, Wicken Fen would quickly become an impenetrable swamp, unmhabitable by many fen plants and animals. To retain the present balance, which represents a typical fen flora and fauna, considerable expense has to be incurred. If the sanctuary is to preserve these fen conditions, a limited amount of human interference is necessary, the cost of which is not met by present

resources A local committee of the National Trust, under Piof J Stanley Gardmer, is responsible for the area, and we are certain that money contributed towards the upkeep and extension of Wicken Fen sanctuary will be wisely spent for the furthering of knowledge of Nature.

THE British Medical Association has been celebrating the Lister centenary at its annual meeting during the past week-appropriately at Edinburgh this yearand, as part of the celebration, has issued a Lister memorial volume, which is one of the most complete that we have seen—"Joseph, Baron Lister" (Edinburgh and London: Oliver and Boyd, 1927. 10s. 6d. net). Apart from a biographical sketch of Lister's life, the work includes a number of reminiscences of 'The Chief' by surviving clerks, dressers, or house surgeons, amongst which is a contribution from the late Prof. Caird, the whole being edited by Dr. A. Logan Turner. An interesting section is that which gives a short account of the careers of Lister's fellowresidents at the Old Royal Infirmary, Edinburgh, in the summer of 1854, a group of men whose after history did not belie the promise of their early years. Two of Lister's addresses are reprinted, together with a number of obiter dicta from his published works. A chapter on the state of surgery before Lister's antiseptic work had banished the infections which too often followed surgical operations brings into full relief the great boon to mankind of his researches. His later surgical work perhaps rather overshadows his earlier physiological experiments, but the latter served as an excellent training and stood him in good stead when he came to devote himself entirely to the advancement of surgery. In virtue of the number of its contributors—upwards of a dozen—the volume gives an impression of completeness which may be lacking in one by a single hand. By perusal of these pages the reader may gain a very good idea of Lister's character and works, and of the development of the science and art of surgery at the period when he revolutionised its practice, the whole revealing a most fascinating story.

In a short note in NATURE of July 9, p. 59, dealing with some recent work in hydrodynamics, the opinion was expressed that during recent years the centre of gravity of pure hydrodynamical research appeared to have shifted to the Continent. The writer had in mind the new orientation given to this subject by the Prandtl theory and its various developments on the theoretical side, and the extraordinarily high degree of experimental skill exhibited in the production of the kinematographic films of fluid motion shown at Prof. Prandtl's recent lecture before the Royal Aeronautical Society. More mature consideration, however, suggests that the opinion so expressed was too sweeping, in that it did less than justice to the large body of British scientific workers who have contributed to this and other branches of hydrodynamical investigation. A wrong impression certamly tends to be created by the tardiness with which completed papers reach publication. Reports and Memoranda of the Aeronautical Research Committee, for example, are not usually available until anything from six to sixteen months after completion of the research. The result is that independent research workers not in direct touch with the personnel at Government research stations may remain for a considerable period in complete ignorance of important developments occurring in their own field.

A VIOLENT earthquake occurred in Palestine and Transpordan on July 11. According to the official report, 268 persons were killed and more than eight hundred were injured. The places that have suffered most are Maan (more than 60 miles to the south of the Dead Sea), Ludd, Ramleh, Nablus (Shechem), Amman, and Es Salt. Some lives were lost and historic buildings were damaged at Jerusalem and the villages round about, the Mount of Olives, Jericho, etc. So far as can be judged from the accounts already received, the centre of the area of destruction lies in the Jordan valley depression, near the southern end of the Dead Sea, the longer axis of the area being parallel to that depression. The last great earthquake in Palestine was that of Jan. 1, 1837. On this occasion the shock was strong enough to cause considerable damage at Beyrout, Damascus, Safad (where 3500 out of a population of 4000 lost their lives), Acre, Tiberias, and Jaffa. The epicentre was probably in the Jordan valley, not far from the Sea of Galilee, and therefore about 100 miles to the north of that of the recent shock. Of the two earthquakes, that of 1837 seems to have been the more violent. A rather strong after-shock was also felt on July 17 at Amman, Es Salt, Haifa, Jaffa, Jericho, and Jerusalem, with its epicentre thus about midway between those of the previous earth-

THE latest report of the Empire Cotton Growing Corporation (report of the administrative council submitted at the sixth annual general meeting on May 26) shows that the useful work which is being carried on by that body continues to expand and to produce good fruit, the production of cotton in the British Empire, excluding India, being 427,396 bales in 1925-26. The outstanding feature of the last twelve months was the fall in price in the latter half of 1926 from 10d. to a little more than 6d., a fall which has been a great discouragement to many growers, causing the abandonment of some areas. Already, however, the price from various causes has risen once more to 9d., and some of the defaulters are probably already regretting their hastiness. In general, though it may delay the hoped-for day when all or most of the cotton used in Lancashire shall be Empire-grown, this reaction will probably work for good by shaking out some of the weaker and more unprogressive cultivators, while at the same time allowing the specialist officers to press on with the breeding of the most valuable and useful types of cotton, and the Corporation and Governments con-

cerned to improve transport facilities before the pressure becomes too great.

THE work of the Empire Cotton Growing Corporation continues to expand, and the unexpended balance to diminish. The work in South Africa is first described, and though results have not yet been all that was hoped for, cotton appears to have come to stay as a crop that may ultimately cover large areas. In Rhodesia the beneficial results of rotation with mealies are becoming apparent—a step in the very desirable direction of regular rotation of crops with cotton, much useful work upon which subject has also been done by Mr. Sampson in Nyasaland, and is now being followed up by the School of Agriculture at Cambridge. Good work is being done in other parts of Africa in the breeding of improved varieties of cotton. The new Research Station in Trinidad is referred to, and the value of the work carried on there is expected to make itself apparent within a comparatively short period. An Imperial Agricultural Research Conference is to be held in October. Finally, the important work upon transport problems is referred to, and the subject of spinning tests is discussed. The whole report is well worth perusal.

UNDER the presidency of Prof. E. T. Whittaker an exceptionally interesting programme has been arranged in Section A (Mathematical and Physical Sciences) of the British Association for the Leeds meeting on Aug. 31-Sept. 7. The foreign guests include Profs. Millikan and Debye, and Drs. Heisenberg and Kolhorster. Prof. Millikan is speaking on the spectra of the elements of the first row of the Periodic Table, and is also giving an evening lecture to the Association on cosmic rays. Dr. Kolhorster will probably also speak on the latter subject in the sectional meeting. A paper by Dr. Heisenberg on recent progress in quantum mechanics will be followed by a discussion in which several English speakers will take part. Members will also have the opportunity of hearing Prof. Debye speak on the polar properties of molecules. Among other papers to be presented, those of Prof. Whiddington, Dr. Aston, and Prof. Barkla are of special interest at the present time. The joint discussion with Section B (Chemistry) on the structure and nature of colloidal particles will be opened by Sir William Bragg. There will also be several subsectional meetings. In mathematics a paper by Prof. Turnbull on non-commutative algebra will serve as a useful introduction to the discussion on quantum mechanics, and, in addition to papers by Profs. Milne and Brodetsky, a morning will be devoted to contributions on the theory of numbers.

In an article published in NATURE of August 28, 1926, Mr. F. J. W. Whipple, the Superintendent of Kew Observatory, made the suggestion that the study of the passage of sound through the high atmosphere might be promoted by systematic observations of the sound of gunfire. He was able to record that he had heard at Grantham seven discharges of a gun on the Shoeburyness range and had been able to

time the passage of the sound. This success has led to the organisation of an experiment which was tried last Saturday. At the request of the Meteorological Office, and with the sanction of the War Office, the times of discharge of a gun on the Shoeburyness range were broadcast by the British Broadcasting Corporation from Daventry and London. There were three rounds fired in the morning and seventeen in the afternoon. Observers were asked to listen for the arrival of the sounds coming through the air. The reports received at Kew Observatory indicate that no observers at great distances were fortunate enough to be able to hear the gun regularly, though there were instances in which likely noises were heard after one or two of the rounds Hot-wire microphones were in operation, however, at four places, and at one of these, the University of Birmingham, good records were obtained The time of passage of the air waves over a horizontal distance of some 130 miles was about 113 minutes. Birmingham must have been in the zone of 'abnormal audibility.' There are not enough observations to define the limit of the zone of normal audibility. The gun was heard intermittently at Romford, but not in the south of London. It is hoped that the broadcasting experiment will be repeated.

Among the activities of the Science Museum, South Kensington, is that of placing on exhibition collections of apparatus and specimens illustrating current scientific research. To some of these temporary exhibitions we have already directed attention. Thanks to the co-operation of the National Physical Laboratory, further collections were opened to the public on July 18 and will remain on exhibition for about four months. One of the new groups of exhibits relates to the research being carried out in connexion with the transport of apples, a matter of importance to the producer, carrier, and consumer. A great deal depends on the ventilation of the fruit stores, and here is shown the control device which automatically admits cool air into the store during the night and excludes warm air from entering during the day. Three exhibits deal with the metallurgy of dental alloys and amalgams, spectroscopic analysis, and British Standardised Steel Preparations. Amalgams are extensively used for dental fillings, but there is need for further knowledge of their properties. Unsatisfactory fitting often arises from the fact that the changes which occur during the mixing, setting, and hardening of the amalgams are only imperfectly understood. In this research microscopic study plays an important part. The exhibit by the Wireless Section of the Natural Physical Laboratory include short-wave transmitters with apparatus enabling wave-lengths to be measured within 1 mm.; a model short-wave receiver for use on wave-lengths of less than a hundred metres; typical examples of elaborate screening arrangements used in connexion with modern radio apparatus; a typical form of modern single frame-coil direction finder and photographs and diagrams illustrating the equipment used for the study of distortion in radio receivers.

A NOTE by Prof R. Verneau in the recent issue of L'Anthropologie (vol 37, Nos 1-2) directs attention to still another case of fraud in alleged archæological discoveries. In this case it is the neolithic mines with human figurines sculptured in chalk, engravings, decorated vases, stone axes, etc, which M. Lequeux claimed to have discovered at Spiennes, near Mons. An investigation carried out by La Service des Foulles des Musées in 1926 failed to find any of the galleries alleged to have been discovered, and the objects therefore remained without evidence of origin. M Verneau recalls a similar unauthenticated discovery of skeletons with bronze masks by M Lequeux in A commentary which needs no elaboration is afforded by the announcement that M Lequeux has just been arrested for violating graves in the cemetery of Montparnasse.

An article by Mr J D. Unwin on "Monogamy as a Condition of Social Energy" in the  $Hibbert\ Journal$ for July is interesting as an example of how anthropological data can be brought to bear upon the interpretation of history. It might even, perhaps, in an ideal State in which social organisation was an intellectual rather than an emotional process, serve to illustrate the practical value of studies at first sight rather remote from the conditions of modern life. Mr. Unwin has attacked the great problem of the historian —the rise and fall of great civilisations and empires. He shows that in the case of Sumeria and the early empires of Mesopotamia, Egypt and Crete so far as we have any knowledge, Greece, Rome, and the peoples of medieval and modern times, such as the Arabs and, up to a point, the British, this rise and tall in power presents a curve which agrees with the curve of progress towards the strictest form of monogamy and the departure therefrom in the relations of the sexes. Recent correspondence in the Tymes has suggested the responsibility of malaria for the decadence of Greece and Rome—a theory which was put forward by Mr W. H. S. Jones some twenty years ago or more. This suggestion is open to the objection that it offers one cause only for a very complex set of conditions, and Mr. Unwin's view would be obviously open to the same criticism did he suggest an immediate connexion. His conclusion is, however, far more subtle and by that so much the more plausible. He suggests that the 'force of life,' which primarily seeks satisfaction in sexual activity, is directed under a strictly enforced monogamy into other manifestations which lead to the advancement of the race or nationconquest, empire, art, and science.

In connexion with the celebration this month of the diamond jubilee of the Confederation of Canada, the Dominion Bureau of Statistics has compiled a handbook entitled "Sixty Years of Canadian Progress, 1867–1927," which is being distributed to libraries, schools, and other institutions. In about a hundred and fifty pages a survey is taken of most aspects of Canadian life, with particular reference to the natural resources and industries. Abundant statistics are given and there are many illustrations and maps, including maps of the growth of Canada, its climate

and forests An appendix gives the text of the British North America Act of 1867.

An expedition to the coast of Labrador for the study of its mollusca has lately left Washington under the auspices of the Smithsonian Institution. The members of the expedition complise Dr. Paul Bartsch, the Culator of Mollusks in the National Museum, and Mr and Mrs. Paul Bowman of the George Washington University. Its headquarters will be on the Matamek River on the south coast, where Mr. C. Amory has offered the use of his camp. The collection of anatomical material is to be the primary object, but special attention is to be paid to the environmental conditions in the places from which specimens are procured, while Mr. Bowman will study the flora and examine the peat bogs of the interior.

In accordance with the recommendation of the recent Colonial Office Conference, a Colonial Medical Research Committee has been appointed as follows: The Right Hon. W Ormsby-Gore (chairman), Sir George Maxwell (deputy chairman), The Secretary of the Medical Research Council (Sir Walter Fletcher), and the Chief Medical Adviser to the Secretary of State for the Colonies (Dr. A. T. Stanton), ex officio, Prof J W. W. Stephens, Sir Leonard Rogers, Dr. Andrew Balfour, Dr. Charles Todd, Dr. P. H. Manson-Bahr, and Dr. C. M. Wenvon. The terms of reference are. "To advise the Secretary of State and the Medical Research Council upon the initiation and promotion of medical research in the interests of the Colonial Empire, upon the recruitment and conditions of service of the necessary personnel, and upon the management and allocation of any funds available for these purposes" The Committee will also investigate proposals for the creation of a Colonial Medical Research Service, and for the payment from a pool of grants to medical institutions which are considered to deserve the support of Colonial Governments.

SPEAKING on July 18 in the House of Lords on the problem of river pollution in Great Britain, Lord Balfour stated that the Government has decided to set up a committee representing the Ministry of Health and the Fishery Board, under the chairmanship of Sir Holace Monro, to advise on the question of new legislation and administration. At the same time, scientific research on river pollution is being undertaken by the following committee: Sir Robert Robertson, Prof. V. H. Blackman, Prof. F. G. Donnan, Sir Alexander Houston, Mr. H. C. Whitehead, and Dr. G. C. Bourne; with Mr. Maurice, Mr Calderwood, Mr. Ronald, and Mr. Simpson-all connected with the Ministry of Health, the Scottish Board of Health, the Fishery Board for Scotland, or the Ministry of Agriculture and Fisheries—as assessors, and Dr. H. T. Calvert as director.

A NEW type of electric cord which acts as a push button at any point of its length is coming into use in Berlin in connexion with electric bells and buzzers and for starting and stopping machinery. It is the invention of Oscar Nagy, a Hungarian engineer. If the cable is squeezed at any point throughout its length, the circuit is completed and the signalling or operating device is actuated. This is effected by having the wires woven into a loose braid separated by an elastic non-conductor, which, however, makes contact when pressure is applied. It is expected that this device can be usefully employed with complicated machinery where threatened accidents to either operator or material make sudden stopping a necessity. It can be operated also by the knee or the elbow, and so has advantages over ordinary types of switches and push buttons. Hidden beneath carpets it would make a useful burglar alarm. In mines and quarries it could be arranged so that a fall or slide of rock would automatically sound an emergency signal

THE Hanbury Memorial Medal, which is given for excellence in the prosecution of promotion of original research in the chemistry or natural history of drugs, has been awarded to Dr T A. Henry, Director of the Wellcome Chemical Research Laboratories.

Dr. R King Brown, for many years Medical Officer of Health to the Borough of Bermondsey, where the practice of artificial light therapy has been extensively carried on under the Public Health Department, and chairman of the executive committee of the Institute of Hygiene, has been appointed medical editor of The British Journal of Actinotherapy.

The following have been elected to fill the vacancies which will occur in the council of the Institution of Electrical Engineers on Sept. 30 next: President: Mr. A. Page; Vice-President: Captain J. M. Donaldson, Hon Treasurer: Lieut-Colonel F. A. Cortez Leigh, Ordinary Members of Council: Mr. J. R. Beard, Major B. Binyon, Mr. P. V. Hunter, Mr. H. Marryat, Mr. H. T. Young, and Mr. D. N. Dunlop.

Some extra copies of the portrait of the late Arthur Bolles Lee, author of "The Microtomist's Vade-Mecum," which was issued with the last number of the Journal of Pathology and Bacteriology are available and may be had by any one interested on application to the editor at 17 Loom Lane, Radlett, Herts. It will be remembered that Mr. Lee died on Mar. 3 last.

The eightieth annual meeting of the Palæonto-graphical Society was held in the rooms of the Geological Society, Burlington House, on July 14, Mr. E. T. Newton, president, in the chair. The annual report referred to the completion of the monograph of the Upper Eocene flora of Hordle, and progress with the monographs of Gault Ammonites and Macrurous Crustacea. It also announced another instalment of the monograph of Palæozoic Asterozoa. Prof. Morley Davies, Dr. F. L. Kitchin, Mr. S. L. Wood, and Mr. Henry Woods were elected new members of council. Mr. E. T. Newton was re-elected president, and Mr. Robert S. Herries and Sir A. Smith Woodward were re-elected treasurer and secretary respectively.

Messes. Cooke, Troughton and Simms, Ltd., have issued a small catalogue (No. 553B) of portable survey

equipment which gives a wide choice of plane table outfits. The instruments cover equipment for purely graphic plane tabling as well as tacheometric instruments, as the pattern used by the Survey of India.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:-An analytical chemist at the Main Drainage Outfall Works of the Dublin Corporation—The Secretary, Local Appointments Commission, 33 St. Stephen's Green, Dublin (July 30). A junior engineer at the Forest Products Research Laboratory, Princes Risborough-The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Aug. 4). A temporary botanist at the Royal Botanic Gardens, Kew-The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Aug. 4) An assistant lecturer in the mathematics department of the Coventry Technical College-The Director of Education, Council House, Coventry (Aug. 5). A lecturer in physics, and assistant lecturers in mathematics, book-keeping, geography, and French at the Belfast Municipal College of Technology-The Principal, Municipal College of Technology, Belfast (Aug 5). An assistant lecturer and demonstrator in botany at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Aug. 6). A male assistant in the geological depart-

ment of the Liverpool Free Public Museums, Liver-Appointments as follow, at the pool (Aug 30) International Institute of Agriculture, Rome -A chief of section specially qualified in tropical agriculture, and editors for, respectively, tropical agriculture, dairy science, plant diseases, fural economics, and trade in agricultural products—The Bureau du Personnel, Institut International d'Agriculture, Villa Borghese, Rome (Aug. 31). A woman B Sc. (physiology or biochemistry) at the Wellcome Physiological Research Laboratories - The Director, Wellcome Physiological Research Laboratories, Beckenham. Two junior assistants under the Directorate of Ballistics Research of the Research Department, Woolwich-The Chief Superintendent, Research Department, Woolwich, S.E 18. An assistant entomologist at the Wellcome Tropical Research Laboratories, Khartoum —The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1. A principal of the Leicester College of Technology-The Director of Education, Leicester. A lecturer in fuel technology at the Imperial College of Science and Technology-The Registrar, Imperial College of Science and Technology, South Kensington, S.W 1.

ERRATUM —In NATURE of July 2, p. 4, col 2, the second term of the left-hand side of the equation should read "2OH,"

### Our Astronomical Column.

COSMIC DUST CLOUDS.—The question of the absorption of light in space by clouds of cosmic dust is a very difficult one, and different observational results seem to lead to inconsistent conclusions. Prof. Shapley's study of the variables in the globular clusters indicates that the phases occur appreciably simultaneously in light of all wave-lengths; further, he finds that the clusters contain stars just as blue as any in our neighbourhood. These and similar facts tend strongly against any general absorption of appreciable amount. On the other hand, the occurrence of numerous regions with sharply defined boundaries, where there is a sudden drop in the stardensity (the Coal Sacks are a notable example), gives cogent reason to believe in the existence of local dust clouds which absorb nearly all the light from stars behind them.

Prof. Edward S King, of Harvard College Observatory, makes the suggestion in a recently issued Bulletin from Science Service, that the group of stars to which the sun belongs, extending outwards to a distance of a hundred light-years, contains a sensible amount of scattered dust. He bases this on observational evidence of increasing redness with distance up to the distance mentioned: after that he finds no further increase in redness. He notes the evidence of a large amount of scattered dust in the Pleiades as being a parallel case. It is well known that the Pleiades nebulæ give spectra similar to those of the stars that they surround, indicating that they shine by reflected light So Prof. King's result implies that the sun is a member of a local cluster somewhat similar to the Pleiades. His evidence for increasing redness with distance up to a hundred lightyears will be awaited with interest.

Shapley's result, mentioned above, shows that the time of passage of light through this cloud does not differ by more than a minute for light of different

colours. This gives evidence of the extreme tenuity of the supposed cloud.

Solar Radiation.—In Smithsonian Miscellaneous Collections, vol. 80, No 2, under the title "A Group of Solar Changes," Dr. Abbot continues his tests of the sun's intrinsic variability, as reflected in the measures of solar radiation made with the pyrheliometer at Montezuma. One test applied is to compare, for any given month throughout the interval considered, the averages of selected pyrholometer measures of total solar radiation with those of the solar constant This selection aims at comparing determinations. measures which have been made under as nearly as possible identical conditions, namely, when the sun is equally high above the horizon, the atmosphere equally clear, the quantity of atmospheric water vapour identical. For the observations discussed, 1921-1926, there is a very good agreement shown for each of the twelve months separately between the pyrheliometer and solar constant curves. On comparing either of these set of curves with that showing the sunspot variation for the corresponding periods, it is seen that a general similarity exists, but it is not so close for all months as was previously found for July, 1910-1920 (see Monthly Weather Review, May 1926).

A useful table is given of monthly averages of solar constant values determined at Chilean stations from 1918 to 1926. Dr. Abbot directs attention to indications in these figures of a 26-monthly period in solar radiation. As additional evidence of related solar and terrestrial changes, monthly solar constant values are compared with (1) ultra-violet radiation values, taken at Mt. Wilson; (2) long-range radio-signal intensities. During the interval, 1924–1926, for which comparisons are available, there is a marked accord. Dr. Abbot is sanguine that his continued investigations of solar radiation will yield useful positive results.

### Research Items.

Man's Origin —Still another view on the place and manner of the origin of man is put forward by Dr E A Hooton in Antiquity for June. Like other recent writers on this subject, he reviews our present knowledge of the geological, palæontological, and archæological evidence in each of the continents. In both Australia and America the probabilities are in favour of the late appearance of man, and the same is the case in South Africa, while the number of finds of the remains of early types of man in Europe lends great weight to the view that man may have originated on this continent. Dr Hooton is not inclined to accept the view recently put forward in favour of Asia, that in that area the modification of environmental conditions was responsible for a progressive modification of the stock, each receding from a common centre with the conditions to which it was adapted. On his view, the variations in man and his immediate precursors originated from generalised forms living in the Lower and Middle Miocene, and were due to the relinquishing of the arboreal habit at various times and at various points in a forest area stretching from the oriental region along the Mediterranean zone to western Europe and in Africa south to the farthest forest zone.

NORTH AMERICAN DIATOMS.—Mr. Charles S Boyer, NORTH AMERICAN DIATOMS.—AIR. CHARLES 5 Doyer, in his "Synopsis of the North American Diatomacee" (Part I. Cosemodiscatæ, Rhizosolenatæ, Biddulphiatæ. Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 78, 1926, Supplement), states that "it is intended to comprise all recent species occurring in North America, including the West Indian" and bosins with a short introduction. West Indies," and begins with a short introduction and survey of the group, the volume in hand including the Centricæ and part of the Pennatæ. Whilst this is a valuable addition to diatom literature, it is by no means complete with regard to the planktonic On p 3, under Habitat, we find the following instructions as to the occurrence of marine diatoms, these are "obtained from dredgings, the scrapings of vessels or pilmgs, the stomachs of fish, the cleanings ot shells, and particularly from the surfaces of salt marshes and tidal pools." No mention is made of tow-nets and water bottles, and apparently the work of the many recent plankton workers, notably Bigelow of the Bureau of Fisheries since 1912 (published 1914 and up to the present tune), has not been consulted at all A beginner studying Mr Boyer's work would conclude that planktonic diatoms only occur plentifully in the open sea, whereas in reality they abound in coastal waters also. One has only to examine the records, for example, from Chesapeake Bay and the Gulf of Maine to verify this. To mention only a few important species which are omitted, we have Asterionella japonica, which occurred in profusion in the Gulf of Maine in 1914 (Bigelow), Guinardia flaccida, Chætoceros densum, Lauderia glacialis, and several others. Skeletonema costatum, that common neritic species, is merely said to be pelagic, and no mention is made of its pro-nounced preference for inshore waters. There is no index and no bibliography, very decided drawbacks in a work which is essentially one of reference, and it is to be hoped that they will be given in a future volume.

Burmese Helminthes—Prof F. J. Meggitt (Journal Burma Research Soc. vol. 15, part 3, 1926) records the results of examination of forty fowls from Rangoon, none of which was free from infection with tapeworms. The number of tapeworms present

varied from ten to several thousands. A species of Raillietina is much the commonest tapeworm in Burmese fowls, but a Hymenolepis is nearly as common while Amæbotænia sphenoides is comparatively rare. In England the common tapeworms of fowls are A. sphenoides and Davainea proglottina, while Raillietina was recorded only twice out of some 200 birds dissected. A key to the adult cestodes of towls is appended. In the same part, G. D. Bhalerao describes the intestinal parasites of bats in Rangoon and gives a list of the Trematoda recorded from Burma.

Canadian Copepods —Prof A. Willey in a description of a new species of freshwater copepod of the genus Moraria from Canada (Proc. U.S. Nat. Mus vol. 71, art 1, 1927) makes some observations on the distribution of copepods Giesbrecht (in 1892) directed attention to the fact that the calanoid fauna of the warmer parts of the ocean exhibits a greater degree of specific divergence than m the North Atlantic Prof. Willey remarks that the reverse is true of freshwater copepods, especially the harpacticoids, in which the number of species increases from south to north, a fact which not only suggests a northern origin for these forms but also points to their Pleistocene derivation. In other words, the northern freshwater harpacticoids as an ecologic group are relict forms of the post-glacial fauna. There is a further point that requires repeated confirmation—it was tentatively assumed by Piof Willey that North American freshwater harpacticoids differ to the extent of certain unit characters from their nearest representatives in the Old World, and he remarks that the present species seems to bear out that interpretation.

NUCLEAR DEGENERATION.—The March issue of Journal of the Royal Microscopical Society, which appears in a new form with larger pages, contains the presidential address by Dr. J. A. Murray on nuclear degenerations following multipolar mitotic cell-division. The material on which the studies described in the address were based was provided by the eggs of the sea-urchin fertilised by two sperms instead of by one. Boven showed that in such cases a tri- or quadri-polar mitotic figure results and the egg divides simultaneously into three or four primary blastomeres, after which cleavage proceeds normally by bipolar mitosis until the blastula stage is reached. But whereas in normal fertilisation each cell of the resulting larva receives a complete set of chromosomes from each parent, in disperm fertilisation the bipartition of each chromosome of the three sets of chromosomes (one from the egg and one from each sperm nucleus) between three or four asters, and consequently between the three or four primary blastomeres, inevitably entails a fortuitous distribution of the daughter chromosomes, so that each cell does not necessarily receive even one complete set of chromosomes. The varying abnormality of the descendants of the primary blastomeres is a consequence of this faulty chromatin distribution. Dr. Murray describes the nuclei of some of the descendant cells in which the chromatin is condensed into a homogeneous, hollow hemisphere in the concavity of which lies a highly refractile achromatic sphere. These cells form a striking feature of larvæ resulting from disperm eggs. In other pathological material, especially in higher animals, there is also the possibility that multipolar cell division, with consequent

derangement of the chromosome groupings, may have taken place, and, as Dr Muiray points out, it is perhaps not without significance that the most frequent sources of nuclear degenerations of this type have been met with in hypertrophic and hyperplastic conditions of the lymphatic glands. Dr Murray gives a group of figures illustrating nuclear degenerations, all taken from lymphomatous tumours of mice, in which the similarity of the appearances to those seen in the pathological echinoderm material is evident, and emphasises the need for attention to forms of cell degeneration in the analysis of pathological processes.

OXYGEN IN THE SOIL —Before the meeting in Washington of the First International Congress of Soil Sciences, Dr Lee M. Hutchins, of the United States Department of Agriculture, demonstrated the operation of an apparatus which he has devised to measure the oxygen-supplying power of the soil The essential part of the apparatus is a hollow vessel of porous porcelain buried in the soil to be studied Pure nitrogen is passed through it and the outgoing stream of gas is bubbled through a solution that changes colour if any oxygen is present. The shade of colour after a given time indicates the amount of oxygen that has passed from the soil through the walls of the vessel and into the nitrogen. Dr Hutchins has been using his invention to study the oxygen needs of such crops as corn and wheat, and also such plants as rice and willow, which can grow in soils that are water-logged and hence very poor in oxygen.

REST PERIOD AND GERMINATION.—Many devices have been used with varying success by plant physiologists to shorten the rest period which seems a necessary precursor to the germination of many seeds In the Malayan Agricultural Journal (vol. 15, No. 3, March 1927) J N Milsum describes some experiments to hasten the germination of oil palm seeds by means of the heat induced by growing seeds under glass. The temperature under the glass frames was 6° F.-18° F higher than the temperature of the open beds. One thousand seeds were planted under glass, and another 1000 planted under normal conditions as a control. After eight weeks, 523 of the heated seeds had germinated to 132 of the control set. After this period the percentage germination in the control beds rapidly approximated to that of the heated frames, so that after twenty weeks the ratio became 928 in frames to 857 in controls. The result of the experiments seems to be that under the given conditions, germination under glass accelerates germination by approximately five weeks.

THE TIDE AT TAHATI.—Under this title, H. A. Marmer publishes in the Journal of the Washington Academy of Sciences, vol. 17, pp 157-184, the results of harmonic analysis of observations extending over Particular interest attaches to tide at Tahati, since this island was considered to furnish a striking exception to the general rule that the tide follows the moon, for it was considered that high tide occurred every day at noon and midnight instead of coming later each day by about 50 minutes. Owing to the small range, amounting to barely one foot at springs, local conditions of barometric pressure and wind made the neap tides difficult to determine. The observations of the U.S. Coast and Geodetic Survey show that there is some progression of the times of high and low water from day to day. This progression is considerably less than 50 minutes about the time of spring tides, and considerably more about the time of neap tides.

Inflammability of Coal Dusts—The degree of fineness of a coal dust mainly determines the ease with which it can be ignited and can propagate flame when raised as a cloud in air. The fineness of a dust is not, however, the only factor on which the inflammability depends, but its chemical properties, which render it of greater or less reactivity towards oxygen, must also be taken into consideration. Paper No. 33 of the Safety in Mines Research Board (London: H.M. Stationery Office, 1927. 6d. net) describes experiments directed towards determining the effect, apart from any other factor, that the chemical composition of a coal dust has on its inflammability. The results disclose a relationship between the inflammability of a dust and its content of 'volatile matter' as determined by standard methods, the more inflammable dusts containing the higher proportions of volatile matter.

THE REFRACTIVE INDEX OF WATER.—An ingenious method for finding the refractive index of a liquid for short continuous electric waves has been described by L. E McCarty and L. T. Jones in the June issue of the Physical Review. A valve oscillator is suspended so as to affect two tuned receiving circuits simultaneously: one is separated from the transmitter by air, and a water trough is interposed in the alternative The two induced electromotive forces are employed to deflect the electron beam in an oscillograph, and the changes which take place in the Lissajou pattern as the thickness of liquid is varied give a measure of the retardation due to the latter, and so permit of calculation of its refractive index. The many experimental difficulties have still to be completely overcome, but it has been found that the refractive index of water is approximately constant and has a value of about 9 for waves of 3 m.-7 m. in length The authors hope to make an elaborate scries of measurements of dielectric constant and of refractive index under conditions as nearly identical as possible.

Subsoil Influences on the Inclination of Radio WAVE -J. E. Carrs, of the Watheroo Magnetic Observatory of the Carnegie Institution of Washington, has recently investigated experimentally the influence of a low resistivity layer subsoil on the forward inclination of radio waves. His conclusions are published in the Journal of the Washington Academy of Sciences, vol. 17, p. 264 It had been suggested that ground water, which is equivalent to a low resistivity layer, would almost entirely annul the forward inclination experienced by radio waves when travelling over ground of considerable resistivity, provided that the depth of the water was only a fraction of a wave-length below the ground surface The survey of the country round Watheroo Observatory showed that the surface layer, down to depths varying from 5 to 10 metres of the sand plain which comprises the greater part of the surrounding country, is of very high mean resistivity. At depths of 60 metres, however, its resistivity is only about one thousandth of what it is near the surface. The country, therefore, was admirably adapted for testing the theory. The Observatory was 132 miles north of the transmitter. The results prove that over soil consisting of a surface layer of sand of exceptionally high resistivity, which at a depth of from 60 to 100 metres had very low resistivity, radio waves of wavelength 1250 metres experienced no forward inclination As the resistivity measurements of the soil had been made with great precision, this gives a definite experimental proof of the effect of ground water, or a layer of low resistivity under the surface, on the polarity of radio waves.

### The Lister Institute.

THE thirty-third annual report was presented by the governing body at the annual general meeting of the Lister Institute of Preventive Medicine on May 18. In certain of the researches carried out by the Institute, the Medical Research Council, the Department for Scientific and Industrial Research, and the British Empire Cancer Campaign have cooperated by providing salaries or grants for the workers engaged: thus the Medical Research Council has provided the salaries of the staff of the National Collection of Type Cultures. On the occasion of the Lister centenary celebrations in April last, an address was presented from the governing body and staff by Sir James K Fowler, in the absence of the chairman, Sir David Bruce

Short abstracts of the scientific researches of the members of the Institute occupy the major part of the report, and are accompanied by a list of papers published during the year. A few only of these are selected for notice in the following account

In the department of bacteriology, Prof Ledingham has shown that the dermal reaction to vaccima virus can be prevented by injection of Indian ink into the cutis, either before or with the virus ably the ink stimulates the reticulo-endothelial system and increases the local defensive powers so that the virus fails in its attack on the tissues. A similar effect is obtained (in the rabbit) if the site of injection of the virus has been previously exposed to the X-ray or to infection by the streptococci of erysipelas. H Schutze and S S. Zilva have completed an investigation on the effect of diet upon the course of tuberculosis in animals guinea-pigs on a diet restricted in quantity were found to be less resistant to the progress of an infection than the In rats, sodium chaulmoograte was without influence on the lesions, but it appeared that a large excess of cod-liver oil or irradiation with ultra-violet light did inhibit their formation: the leucocytosis simultaneously produced is not the only agent in this inhibition, if concerned with it at all.

In the department of biochemistry, W. T. J Morgan has prepared the  $\alpha$ - and  $\beta$ -methyl hexosidediphosphoric acids from hexosediphosphoric acid, and is attempting to obtain the methyl hexoside from the former by means of Robison's bone enzyme. In collaboration with H. P. Marks he has shown that neither the mono- nor the di-phosphate will relieve the symptoms of hypoglycæmia in rabbits and mice following injections of insulin R. Robison has continued his work on the phosphoric esters occurring in blood, and has found that these compounds account for nearly all the acid soluble phosphorus present in this fluid: at the same time a compound which does not contain phosphorus but reduces alkaline copper solutions has been isolated and is being examined. He has also found that the bone enzyme will produce phosphoric esters synthetically, under suitable conditions, from inorganic phosphate and glycerol, glycol, mannitol, glucose, etc. In further experiments on calcification in vitro, the same author has shown that deposition of calcium phosphate in rachitic bones occurs when so little as 5 mgm. calcium and 5 mgm. morganic phosphorus per 100 c c. are present in the surrounding solution, provided that phosphoric ester is also present: so little as 0.5 mgm organic phosphorus per 100 c c has a significant effect, and the deposit increases proportionately to the increase in the ester

In the department of experimental pathology, the director of the Institute, Sir C. J. Martin, and Elizabeth Lepper have continued their investigations on the protein error of indicators in the case of horse-serum it was found that the serum-albumin diminished the colour of phenol red and neutral red, whilst the pseudoglobulin increased it Prof. Korenchevsky has found that after thyroidectomy, rabbits show a more pronounced fall of body temperature on cooling, and much less increase on warming, than normal animals. Castration has similar but less-marked effects, but para-thyroidectomy is without influence. Thyroid feeding will restore the power of adjustment to normal, but in excess will cause a marked rise of temperature under conditions previously well borne.

Work on vitamins includes assays of cod-liver oils carried out by the Institute on behalf of the Health Committee of the League of Nations: Miss Hume and Miss Henderson Smith have developed a new technique for vitamin A, in which the test material is fed to the experimental animals from the commencement of the experiment, the amount given to different animals mcreasing in geometrical proportion. For vitamin D assay, Miss Soames and Miss Leigh-Clare have worked out a basal diet containing both vitamin A and phosphorus in adequate amounts. They have also found that the vitamin D content of cod-liver oils is more uniform than the vitamin A content, and have obtained agreement between the biological method of assay of vitamin A and the colorimetric titration by the method of Drummond and Rosenheim. Miss Leigh-Clare has also been unable to detect any vitamin D in the marine diatom Nitzschia, so that this organism cannot be regarded as the ultimate source from which the cod obtains the antirachitic vitamin stored in its liver oil Miss Hume, Dr. Lucas, and Miss Henderson Smith have found that young rats and rabbits are protected from rickets when 0 2 gm irradiated cholesterol in hardened cotton seed oil is daily applied to an area of depilated skin equal to about one square inch, lending support to the idea that vitamin D may be synthesised in the skin when ultra-violet rays fall upon it. T. Lumsden in experimental researches on cancer has found that the immunity of an animal to an homologous tumour is the result of two factors: antibodies in the blood serum and some excretion from the white blood corpuscles when they have extravasated and are subject to a low oxygen tension.

In the department of protozoology, Dr Muriel Robertson has performed experiments on the parabasal body of the free-living flagellate Bodo caudatus: after treatment with acriflavine, a proportion of the organisms, otherwise appearing normal in their behaviour, were found to have lost the parabasal body, and in their progeny it is also absent. In studies on Heteromita it was found that, after nuclear division, the daughter cells sometimes failed to separate; the double individual which results from this non-separation gives a most realistic simulation of conjugation, so that it is not yet certain that the latter process occurs in this form.

In the department for the study and preparation of antitoxic sera, it has been found that with continued subcultivation in ordinary laboratory media the streptococcus tends to change its characteristics. Recent cultures are hæmolytic, virulent to mice, and appear 'rough' in broth medium, whereas the older cultures, into which the former tend to pass, are non-hæmolytic, less virulent, and 'smooth' in character. Their antigenic relationships are being investigated.

### The Spacing of Young Trees.

FOR some time past there has been a certain amount of dissatisfaction amongst a section of members of the Royal Scottish Arboricultural Society with the Transactions, it being held that the publication was behind the times, both in appearance, arrangement of material, and so forth. In the recently issued number for March 1927 the Council has taken the step of rechristening this conservative magazine as The Scottish Forestry Journal, though otherwise it remains unchanged Amongst the chief matters of interest in the present number is the attention given to spacing in planting in Great Britain, a point of vital importance The matter was given a prominent place in the presidential address of Sir Hugh Shaw Stewart to the Society last February (which is reproduced in this number), and was commented upon by partisans of both wide and close spacing during the ensuing discussion. It was touched upon by Lord Lovat in an address, also printed, and forms the theme of other writers.

It might appear, from some of the opinions expressed, that this question as to whether better results can be obtained by planting the young trees in the first instance at a closer or wider interval was a new problem. If it is new in Britain, it is merely due to the fact that when we commenced to plant conifers last century, we did so in ignorance of the methods in force on the Continent of Europe and knew nothing of that necessary concomitant—scientific thinning. The advocates of wide spacing, which, chiefly on account of the far heavier costs of planting since the War, is being practised both by the Forestry Commission and others, have, it must be confessed, few proofs to support their contention that they will obtain as good a quality of timber. That, in other words, they are not risking the reproduction of the inferior article which brought British timber into such disrepute that foreign conifer timbers were always preferred, if not demanded, even by the British Government Departments This question cannot be divorced from a consideration of the manner of growth of the larger area of the forests of the globe, which are of natural origin. In a naturally regenerated forest the young plants come up densely, and with proper attention are gradually thinned out. It would appear that those who advocate closer planting based on this analogy have a strong case.

The problem has to some extent become involved owing to the so-far-observed development of young plantations of Douglas fir. In many parts of Britain there has been an extraordinary variation in development of individuals in young Douglas woods in which the young trees were all of the same age and size when planted It may be agreed that the ordinary British planting distance of 4 ft. by 4 ft. or thereabouts, at first adopted for Douglas, was too close This is true, and, moreover, remains true for most exotic trees in any part of the world when introduced into a climate and under conditions which result in their growing very much faster in their early years than in their own habitats A forester going to the tropics has to revise all the ideas as to planting distances with which he became acquainted in temperate Europe. But because 7 ft or 8 ft. spacing may be correct for Douglas in Britain or parts of Britain, to apply the same spacing or anything near it to Scots pine, the spruces, and some other species is, in the opinion of many, to court disaster; or, at any rate, to reproduce an inferior British timber

Experiments are in existence in the form of sample plots and so forth, the object of which is to endeavour to provide rule-of-thumb information on this matter. But as we shall have to wait some thirty years or more ere results of any value are obtainable from them, it would conceivably be a wiser policy to imitate Nature as closely as possible, and not to hurry the planting campaign forward at the expense of the future quality of the marketable timber.

### Properties of Nickel- and Nickel-Chrome Steels.

EXTENSIVE researches on the nickel- and the nickel-chromium steels are described in a recent publication from the Bureau des Poids et Mesures <sup>1</sup> The memoir deals with work commenced in 1896 and continued consistently during the intervening years. Certain of the results have already been published in part from time to time, but the present collection serves a very useful purpose in bringing together in one volume work which has been spread over many years and published in very different places. Further, the results are now available in greater detail than has hitherto been the case.

Detailed descriptions are given of the apparatus and the methods used in the measurements, the majority of which, however, are by now fairly widely known. The properties chiefly investigated are magnetic—the Curie point, the dilatation and the torsional modulus of elasticity. The account of the work on the nickel steels by M. Guillaume deals in the main with changes in these properties over a relatively small temperature range, but M. Chevenard considers the changes in the nickel-chromium steels up to quite high temperatures.

One of the most interesting aspects of the work is the interpretation offered of the well-known but curious properties of 'invar' and the less generally

1 "Travaux et Mémoires du Bureau des Poids et Mesures." Publics sons les auspices du Comité International, par le Directeur du Bureau Pans, 1927. known, but equally interesting, constancy of the modulus of elasticity with temperature of the nickelchrome steel to which the name 'clinvar' has been given. In each case the presence of an intermetallic compound is invoked in order to explain the results, compounds which are not believed by all metallographers to have any real existence. Regarding the one which is believed by the authors to occur in 'invar,' it is stated that "this compound Fe<sub>2</sub>N<sub>1</sub> is formed with expansion, and its magnetic transfor-mation is accompanied by an anomalous negative dilatation and by an exceptionally large positive thermo-elastic anomaly. Its presence explains the appearance of the minimum in the curves of density and modulus of elasticity with composition at the ordinary temperature." The ferro-nickels which contain chromium show a reversible magnetic transformation just as do the pure iron-nickel alloys. The higher the content of chromium for the same amount of nickel, the lower is the Curie point and the less pronounced are the anomalies of dilatation and elasticity. This intense diluent effect of chromium appears to point to the presence of a compound Ni<sub>2</sub>Cr<sub>3</sub>, and one may obtain alloys either of a determined dilatability or of constant elastic properties as in 'elinvar.' The latter alloy, in addition to nickel and chromium, actually contains carbon, manganese, and tungsten.

So far as more directly important practical applica-

tions of these steels are concerned, M Chevenard says that "chromium exerts a very favourable influence upon the mechanical properties of the austemitic nickel steels, especially at high temperatures At the same time it renders these alloys very resistant to oxidation and to the attack of a large number of corrosive agents." These facts are already being applied industrially in the newer varieties of stainless iron and steel.

The volume ends with a paper on butt-ended standards of length which forms the continuation of

previous work

### The Supply of Information.

IN October 1924 the President of the Board of Education appointed a Departmental Committee to inquire into the adequacy of the library provision already made under the Public Libraries Acts, and the means of extending and completing such provision Those who recognise that an efficient library system is the essential foundation for progress in education and culture, without which no people can hold its own in the struggle for existence, will welcome the Report 1 of the Public Libraries Committee, a volume of some 350 pages now published, as offering the basis

for a reorganisation long overdue.

The Committee recommends a national system of co-operation between libraries, whether borough, urban district, county, or special, with the Central Library for students, reconstituted as a department of the British Museum, acting as a central bureau of exchange for the whole system, and as a national lending library to supplement the resources of other libraries. It is contemplated that, in the first place, an application for a rare or expensive book needed for the purposes of research will be made to the local public library. If the public library does not possess the book and does not consider it reasonable to buy it, the librarian will refer to the 'regional library, provided such an organisation has come into being. If the regional library cannot supply the book, the application will be sent to the Central Library. The Central Library will supply the book from its stock, endeavour to borrow the book from the institution likely to possess it, accepting responsibility, or purchase the book.

A considerable proportion of the books for which application will be made under this scheme will be scientific literature, and in particular scientific periodicals. The necessity for a central library to provide for the needs of scientific workers has been widely recognised and was emphasised by Dr. Chalmers Mitchell at a conference of the Association of Special Libraries and Information Bureaux in 1925, when he said: "Some of the periodicals are contained in no library in Great Britain. I am glad to be able to state that the Library of the Science Museum is making a great effort to fill the gap. In my view there is no more urgent need than the establishment in this country of a central library, the duty of which shall be to contain a copy of every periodical publish-

ing scientific research."

The nucleus of such a library already exists in the Science Library at South Kensington, with its great collection of periodicals. The Committee suggests that the most easy and least expensive way of solving the problem will be to make the Science Library complete, and it recommends that an additional sum of £3500 a year, with a small contingent increase of staff, should be granted to enable the Science Library

<sup>1</sup> Public Libraries Committee Report on Public Libraries in England and Wales, pp. 356. Cmd. 2868. (London H M. Stationery Office, 1927) 6s. net.

to obtain most of the volumes of which it stands in need. The Science Library has already assumed many of the functions of a central library, by the extension of borrowing facilities to approved institutions where scientific or technical work is carried on, and should be the principal source on which the Central Library will depend for the supply or loan of books needed by research students in science.

If scientific research is the foundation of commercial prosperity, it is no less true that such research cannot be carried out efficiently without the means of consulting the records of previous work The organisation necessary to secure this end would not be very great It is estimated that the cost of all the proposals, including those relating to the Central Library and the Science Library, would not exceed £12,000 a year during the next few years, while the benefit to learning, research, manufactures, and trade can scarcely be estimated.

### University and Educational Intelligence.

EDINBURGH —At the recent graduation ceremonial, the honorary degrees conterred included the following: Doctor of Divinity. The Right Rev. Ernest William Baines, Lord Bishop of Birmingham. Doctor of Laws Sir John Carruthers Beattie, Vice-Chancellor and Principal of the University of Capetown; the Abbé Henri Breul; Prof C. F. Jenkin, professor of engineering, University of Oxford; Prof. J C. Meakins, professor of medicine, M'Gill University, Montreal, Prof. A. C Seward, Master of Downing College and professor of botany, University of Cambridge. The degree of Doctor of Science was conferred on Douglas A. Allan, thesis—"The Geology of the Highland Border from Tayside to Noranside", T. W. M. Cameron, thesis—"Studies in Economic Helminthology". John Maggiere Cowen, thesis—"The thology"; John Macqueen Cowan, thesis—"The Forests of Kalimpong—An Ecological Account"; J F V Phillips, thesis—"Forest Succession and Ecology m the Knysna Region"; C. M Yonge, thesis—"Structure and Function of the Organs of Feeding and Digestion in the Septibranchs, Cuspidaria, and Poromya"

LONDON .- A course of four lectures on "Heat Transfer in Reciprocating Engines, including Internal Combustion Engines," will be given (in English) by Prot. Dr. Adolf Nagel, professor of engineering in the Technische Hochschule, Dresden, at the Institution of Civil Engineers (by kind permission) on Oct. 11, 14, 18, and 21, at 5 30 PM. The lectures will be illustrated by lantern slides Admission is free, without ticket.

The International Federation of University Women in its Occasional Paper, No 6, describes Crosby Hall, the Federation's new office which was recently opened by the Queen as a club-house. University women carrying on research or other post-graduate work in London will be eligible for residence at the Hall, if members of the Federation, and the dining-hall and common rooms are available for all members visiting or living in London. The same pamphlet contains addresses by Prof. Zimmern and Prof. Kristine Bonnevie on the work of the League of Nations Committee on Intellectual Co-operation and the Federation's collaboration with it, and a note on the functions of the American National Committee on Intellectual Co-operation, described by Prof. Zummern as the model national committee. American committee, organised at the beginning of last year, undertakes to procure or compile whatever information from the United States may be needed in connexion with any investigation being made by the International Institute of Intellectual Co-operation, the working instrument of the League of Nations Committee. It has been interesting itself in the question of obtaining financial support for the Geneva School of International Studies and for a working library for the Institute. The Federation has a committee on standards which is engaged in investigating the thorny problem of assessing the relative values of the degrees and diplomas granted by the various universities and other institutions of university standing.

THE Trustees of the Bert Fellowships for Scientific Research at their recent twelfth annual meeting elected the following to fellowships, the proposed course of research being indicated after the Fellow's name: Mr. I. Vogel, ring formation (Organic Chemistry Laboratories of the Imperial College, under Profs. H. B. Baker and J. F. Thorpe); Mr. K. V. Thunann, the effect of electrical currents on proteins (Bio-chemistry Department of the Imperial College, under Sir John Farmer and Prof. S. B. Schryver), Mr. A. G. Forsdyke, the nature of the motion in the wake of a body moving in a viscous fluid as a contribution towards the problems of fluid resistance (Mathematics Department of the Imperial College, under Profs. S. Chapman and H. Levy). All these fellowships are of the value of £250 a year and tenable at the Imperial College of Science and Technology. In addition, the Trustees approved the extension for a second year of the fellowships held by Mr. J. Topping for research on the mechanical equilibrium of crystal lattices, Mr. J. W. Maccoll for studies in the motion of viscous fluids, and Mr. G. H. Mitchell for further work on the geology of the Borrowdale volcame series of Kentmere, Westmorland The experiment during the past year, under which the tenure of these fellowships was tentatively made for two years instead of one year as before, having proved successful in every way, the Trustees have now adopted it as the tenure basis of the new fellowships now announced and of future awards.

The report on the work of the Department of Petroleum Technology of the Sir John Cass Technical Institute for the session 1926-1927 has recently been issued, and in it the Principal, Mr George Patchin, is able to show some satisfactory results of development. Since the last annual report (1925–26) the Department has been enlarged by the addition of a Petroleum Technology Laboratory with a fully equipped lecture room adjoining the same; it is hoped that this extension will provide the necessary facilities for advanced study and research The schedule of lectures given during the past session comprises lectures on petroleum technology (in three parts), introduction to the chemical and physical properties of petroleum, properties, applications, and examination of petroleum, and the applications of engineering and mechanical drawing. For those who have little or no previous knowledge of the fundamental sciences, there is a preliminary course, including elementary chemistry, physics, and practical mathematics. It is not clear from the report what subjects are comprised in the petroleum technology course, other than part 3 dealing with internal combustion engines and colloids in relation to petroleum. It is to be hoped that provision is here made for those who wish to acquire some knowledge of the geological aspects of the industry, also that the important subject of economics of petroleum is included. Close contact has been kept between the school and various oil companies in London; in this connexion lectures have been given by members of the staffs of the latter, and thus essential practical knowledge is placed at the disposal of the students, a vital factor in the training of all concerned with the petroleum industry, whatever particular branch is favoured.

### Calendar of Discovery and Invention.

July 24, 1747.—About the same time that Franklin was experimenting on lightning conductors, William Watson (1715–1787) made experiments which appeared to show that the passage of electricity was instantaneous. Some of these experiments were made in the summer of 1747. On July 24 of that year Watson, assisted by Charles Cavendish and Martin Folkes, sent a charge of electricity through 800 feet of water at the New River, Stoke Newington. The following year Watson, at Shooter's Hill, also sent discharges through 12,276 feet of wire.

July 24, 1842.—"That a glacter moves like a

July 24, 1842.—"That a glacier moves like a sluggish river, and under the same laws," wrote J D. Forbes, "was an idea which first clearly entered my mind as a definite probability on the evening of the 24th July 1842, when from the heights of the Charmoz I saw the dirt bands stretching across the breadth of the Mêr de Glace at my feet like floating seum on a partially stagnant stream . . . and from that hour the viscous or plastic theory was to me a conviction and a reality."

July 25, 1675.—Halley was the son of a wealthy soap boiler whose town house was in Winchester Street, in the city of London, and it was here that Halley, on July 25, 1675, observed an eclipse of the moon. He was then nineteen years of age and this eclipse formed the subject of his earliest published observations.

July 25, 1909.—The first flight in an aeroplane across the English Channel was made by Louis Blériot, who on July 25, 1909, crossed from Calais to Dover in a monoplane of 28 feet span, weighing with the pilot 462 pounds. The machine was fitted with a three-cylinder Anzani engine developing 24 horse-power.

July 26, 1790.—What was probably the earliest advertisement of a steamboat appeared in the Federal Gazette and Philadelphia Dauly Advertiser on July 26, 1790. This gave notice: "The Steamboat sets out to-increw at 10 o'clock from Arch Street Ferry, in order to take passengers from Burlington, Bristol, Bordentown, and Trenton, and return next day. Philadelphia, July 26, 1790" The steamboat referred to was one of those built by the unfortunate pioneer, John Fitch.

July 28, 1851.—In the development of the study of the various phenomena associated with total eclipses of the sun, especial interest is attached to the total eclipse of July 28, 1851, observed with success in Norway and Sweden. It was on this occasion that the prominences were closely followed and described. Hind wrote of "a long range of rose-coloured flames"; Dawes of "a low ridge of red prominences, resembling in outline the tops of a very irregular range of hills," while Airy termed the portion of this "ringged line of projections" visible to him the "Sierra."

July 29, 1857.—An outstanding improvement in the manufacture of iron rails was the introduction of the 'three high mill,' in place of the 'two high mill.' The story of its introduction was told by the great American ironmaster, John Fritz, in 1899. Declared by others "a visionary scheme and one that had never been done before, and had it been practical it would have been done long ago," the first 'three high mill' was put into action by Fritz himself at the Cambria Iron Company, U.S.A., making the company a great financial success and giving it a rail plant far in advance of any other plant in the world.

July 30, 1828.—An account of the Brownian movements witnessed by Robert Brown was privately circulated under this date, with an additional account the following year dated July 29, 1829. E. G. S.

### Societies and Academies.

#### LONDON.

Royal Society,  $^1$  June 30.—A. Fage and F C. Johansen. On the flow of air behind an inclined flat plate of infinite span. The airflow behind a flat plate has been explored with a heated wire, used in conjunction with an Einthoven galvanometer. As the inclination of the plate is decreased from 90°, both the frequency and velocity with which individual vortices behind the plate pass downstream become greater, and the longitudinal spacing between successive vortices becomes smaller. Vorticity is shed at the same rate from the two edges of the plate; this rate slowly decreases with the inclination of the plate Only a part of the vorticity generated at the edges passes downstream in the form of well-defined vortices

L. G. Brazier: On the flexure of thm cylindrical shells and other 'thm' sections St. Venant's solution of the flexure problem shows that hollow beams are more efficient than solid beams in economy of material. His theory suggests that this advantage increases without limit as the cylinder is made of thinner material. Actually a limit is reached when the section fails under flexure by distortion of the cross-section. The distortion of the cross-section of 'thin' section beams subjected to pure flexure is examined and a modification to St Venant's result is obtained. The analysis suggests the existence of a form of elastic instability, characterised by the absence of a 'point of bifurcation,' for beams of such sections subjected to pure flexure.

W. H. George and H. E. Beckett: The energy of the struck string (Part II.) The initial velocity of the hammer does not determine the character of the impact, and the fraction of its initial energy lost by the hammer is independent of the initial velocity of the hammer. The results obtained with an actual felt-covered pianoforte hammer are remarkably like those for a pointed or a broad unyielding metal hammer. A specially designed yielding metal hammer gave less energy to the string than did any of the other types of hammer. The partition of the energy among the various partial tones of the vibrating string shows that it would be possible to obtain almost any kind of tone quality from a pianoforte merely by altering the mass of the hammer.

G A. Tomlinson: Rusting of steel surfaces in contact. Hardened steel surfaces m contact and subject to relative motion are liable to become stained with a deposit of oxide, which may cause trouble in high-precision apparatus. This effect trouble in high-precision apparatus. occurs with quite small contact stresses and with various different materials in contact with steel. It is necessary that relative tangential motion shall occur. An oscillatory tangential motion of  $8\times10^{-8}$  inches, repeated sufficiently often, will produce oxidation débris, but smaller motions do not. This suggests that actual molecules are detached by cohesion forces and combine with oxygen molecules from the air. The effect of a film of castor oil between the surfaces has been examined. A sphere and a plane can be completely separated by a film of great mechanical strength, when the mean intensity of pressure over the area of contact is less than a critical value of about 65,000 lb. per square mch. For pressures above this, the film may rupture and solid cohesion occur, accompanied by the same oxidation

F. I. G. Rawlins and E. K. Rideal: The absorption spectra of aragonite and strontianite in the near infra-red. Definite displacements of the three

<sup>1</sup> Continued from p. 103

fundamental frequencies of the CO3-- ion occur in the two crystal forms From the overtones of the fundamental at  $7\mu$ , it is shown that the frequencies do not follow the order  $3\nu_1$ ,  $2\nu_1$ ,  $3\nu_1$ ; a correction must be introduced analogous to the Kratzer correction for an harmonic coupling in gases In CaCO3 this correction is greatest for the less symmetrical form. In bi-axial crystals of the carbonates of calcium, strontium, and barium, the absorption wave-length at  $\nu_1$  (7 $\mu$ ) and its overtones increase with the molecular volume, but the reverse is the case for the bands at  $\nu_2$  (14 $\mu$ ) and  $\nu_3$  (11 $\mu$ ). This dependence upon the molecular volumes is likewise observed in calcite and

C. N Hinshelwood and P. I. Askey. The influence of hydrogen on two homogeneous reactions. The decomposition of propionic aldehyde is unimolecular at low pressures if sufficient hydrogen is present Increasing pressure of hydrogen soon brings the propionic aldehyde reaction to a limiting rate, which is the same as the limiting rate reached when the partial pressure of the aldehyde itself is increased Similar pressures of hydrogen have no tendency to make the acetaldehyde decomposition appear unimolecular, and no saturation value is reached for the comparatively small effect which the hydrogen exerts. These phenomena indicate that activation of acetaldehyde involves a few degrees of freedom only, while that of propionic aldehyde is a more complex process, and that in the propionic aldehyde reaction there is a time-lag between activation and transformation.

H. Stanley Allen and Ian Sandeman: Bands in the secondary spectrum of hydrogen (11.) A system of bands of a distinctive type occurs in groups throughout a wide range of the visible and infra-red spectrum of hydrogen. The bands in a group have been spaced out at intervals of very nearly 92 wave-numbers, and various reasons have been given for attributing the system to triatomic hydrogen,  $H_3$ . A considerable number of new bands has now been added. The structure of some of the better defined bands suggests

that the spacing depends on a new quantum number. G. D Bengough, J. M. Stuart, and A. R. Lee. The theory of metallic corrosion in the light of quantitative measurements. A new version of the electrochemical theory of metallic corrosion has recently been widely accepted as fitting satisfactorily experimental facts, from a qualitative point of view, but the theory has not been subjected to exact quantitative examination. A method of measuring corrosion has been worked out, based on the determination of the amount of oxygen absorbed during corrosion, and has been applied to the metal zinc. The nature of the surface of the metal is an important factor in determining corrosion. Reasonable agreement between duplicate experiments has only been obtained with specimens annealed in argon at temperatures in the neighbourhood of 250° C. 'Spectroscopically' pure zinc is readily attacked by N/10,000 KCl solution; in solutions between N/20,000 and N/5000 KCl the time-corrosion curves are of exponential form during their earlier course, and the controlling factor appears to be the number of chlorine ions initially present in, and their rate of withdrawal from, solution. later course of the curves appears to be controlled largely by the behaviour of films of corrosion products. With stronger solutions the amount of available oxygen becomes an important factor.

H. A. Wilson: Chemical equilibrium in a mixture of paraffins. The compositions of the gaseous and liquid phases of a mixture of paraffins,  $C_nH_{2n+2}$ , when in a state of chemical equilibrium, are worked out approximately as functions of the temperature and pressure. A chart is drawn on which the equilibrium

composition of the phases can be read off. The results obtained enable the temperatures and pressures at which the maximum amount of any particular paraffin is present in the vapour to be determined. The amount of the gaseous phase which condenses when the temperature and pressure are changed can also be obtained.

Physical Society, June 10.—J. H. Awbery. The latent heat of evaporation of sulphur. The latent heat of evaporation of sulphur was determined by finding the loss of weight of a vessel full of sulphur when energy was dissipated in it at a known rate. Heat losses were prevented by immersing the vessel in the vapour of sulphur. The value found for the latent heat was 79, the accuracy being estimated at 2 per cent.—H Lowery. The refraction and dispersion of gaseous carbon tetrachloride. The refractive index has been found for the green mercury line ( $\lambda 5461$ ), the result being expressed in connexion with the density of the gas, that is, so as to show the refractivity of the gas by the same number of molecules as 1 c.c. of hydrogen contains at N.T.P. Adopting the value 1.001799 for the refractive index under these conditions, the dispersion of the gas over the range  $\lambda4800$  to  $\lambda6700$  is represented by the expression  $\mu-1=13~543\times 10^{27}/(7831~7\times 10^{27}-\nu^2),~\nu$  being the frequency of the light —P. K. Kichlu: Regularities in the spectrum of ionised neon. A number of lines lying between  $\lambda 7282$  and  $\lambda 3142$  occurs in the condensed discharge spectrum of the more volatile gases of the air. These have been attributed to singly ionised neon, and the present work confirms this

Royal Anthropological Institute, June 28.—V. G. Childe: The Ægean and the Danube valley in the second millenium B.C. The Central European bronze age was the child of the Ægean but eventually turned upon its parents and devoured them. Recent excavations in Hungary and Macedonia have thrown light on this double process In the lowest strata at Toszeg near Szolnok on the Tisza, the connexion with Troy is clearly revealed in the pottery, and at the same time a link is found with the early bronze age civilisation that arose round the tin deposits of Bohemia. In the fourth layer at Toszeg, an intrusive pottery appears that is identical with a foreign ware found by Mr. Heurtley in a sub-Mycenæan context in Macedonia This fabric was native neither to Macedonia nor to Hungary, but originated round the headwaters of the Adir and March. Its authors could be traced as far as Thessaly and central Greece. Were they the Dorians of Greek tradition?

### PARIS.

Academy of Sciences, June 13.—Marcel Brillouin. The earth's magnetic field and the internal electromagnetic properties of the globe.—J. Costantin: The economic and agricultural importance of cultivation in tropical mountain regions. An account of the fight against the sugar-cane disease (Sereh) in Java. The simplest treatment, and the one in general use, is to raise the cuttings of the plants in the mountains, first at an altitude of 1500 m. to 1800 m., then removal to nurseries at a height of 600 m. to 700 m., and finally removal to the plain. The regenerated plant remains free from disease for about five years. A modified treatment is to cross the Java cane with a mountain variety from the lower slopes of the Himalayas and to give this the mountain cure as above, about every six years.—Gabriel Bertrand and L. Silberstein: The amount of total sulphur in arable soil. Analyses of soil from various parts of

France showed the total sulphur to vary between wide limits-0.202 gm. to 5.175 gm. of sulphur per kilogram of dried soil. It was noticed that the regions nichest in sulphur were also the most fertile.—A. Desgrez and H. Bierry: The variations with the diet in the elimination of the urinary carbon in diabetics. Two ratios have been experimentally studied,  $A = (C_t - C_g)/N_t$ , where  $C_t$  is the total carbon in the where  $C_u$  is carbon as urea and  $N_u$  the nitrogen as urea. Both these ratios are at a minimum during the period of an equilibrium diet, and the measurements of these ratios establish with precision the value of a particular diet for diabetics.—Beniamino Segre The transformation of R networks.—A. Buhl: The symmetries of the theory of continued groups.— Léon Pomey · The normal integro-differential equations of infinite order.-V. A. Kostitzin: The singular solutions of the integral equations of Volterra—René Lagrange · an algorithm of series —M Lavrentieff · Conformal representation.—Spyridion Sarantopoulos · The meromorph functions represented by a Taylor's series with rational coefficients.-Martin Alander: A property of meromorph functions at the interior of a line of constant modulus—(i. H. van den Dungen: The calculation a priori of the vibrations of bending and other vibrations -Andre Défour. The utilisation of the tides —André Charrueau: The figures of equilibrium relative to a liquid mass in rotation, to the Newtonian attraction between its particles and to the surface tension.—J Ubach: Observations of the eclipse of the sun of Jan. 3, 1927, at Buenos Ayres (Argentine Republic). 94 photographs, 81 of which could be utilised for measurements, were taken under very favourable conditions. -Robert Esnault-Pelterie and Osée Marcus theoretical electrical resistance at the contact of two elastic conducting spheres, disregarding the passage layer—Emmanuel Dubois . The Volta effect. If a metal is heated in a vacuum, it is found after cooling that the heating has rendered it electro-negative, provided that the heating has been sufficiently prolonged and carried out at a sufficiently high temperature From the experiments given it would appear that the variations in the electromotive force obtamed after heating an electrode in a vacuum arise from the disappearance of impurities common to all metals — Rouelle: Certain peculiarities of ferro-resonance when the resistance is not negligible.

—E. Pierret: The Barkhausen oscillations obtained with French valves.—Nicolas Perrakis: The magnetic properties of vanadyl chloride and sulphate and the atomic moment of tetravalent vanadium. experiments cited prove that VIV possesses at least two atomic moments, one of 8 and the other of 9 magnetons. — Jacob: An experimental method permitting the comparison, at a given moment, of the velocity of light in one sense and in the opposite sense. — Duffieux: The production of the continuous spectrum of mercury by rotation in a vacuum. A detailed account of the phenomena observed when a drop of mercury is placed in a spherical evacuated glass globe, maintained in rotation (120 to 180 turns per minute), and the temperature slowly raised to a maximum of about 200° C -G. Reboul: The production of X-rays without a focus tube.—E. Darmois: The rotatory power of tartaric acid in solution in calcium chloride.—René Audubert: The application of the radiochemical theory to solutions of sodium iodide.—W. Kopaczewski and W. Szukiewicz: The rôle of some physical factors in the electrocapillary penetration of coloured colloids.—A. Boutaric and G. Corbet: The critical temperatures of solution of

mixtures of alcohol and some hydrocarbons. method given, specially designed to deal with mixtures possessing a low critical temperature of solution, was used to show that although benzene and pure alcohol are miscible in all proportions, contrary to the view generally held, petrol and absolute alcohol are not miscible in all proportions.—Eugène Cornec and Paul Klug. The boiling of saturated solutions, a method of physico-chemical analysis -F. Bourion and E. Rouyer. The boiling-point study of the affinity relating to the complex compounds formed from mercuric chloride and alkaline chlorides.—Svend Aage Schoù: The transformation of acetaldehyde into its The change has been followed by the quantitative study of the ultra-violet absorption of neutral, basic, and acid solutions of acetaldehyde.-A Job and G. Dusollier: Organo-magnesium compounds containing phosphorus. Study of the reaction between ethyl-magnesium bromide and mono- and The magnesium compounds diphenylphosphine obtained react with ethylchloroformate -M Wilmet . The sensibility of some test papers towards gaseous phosphoretted hydrogen Papers containing silver nitrate or mercuric chloride are capable of showing the presence of 1 part in 1,000,000 of gaseous phosphine—C Dosios and G. Leucaditis: The mechanism of the formation of ketones during the dry distillation of the salts of organic acids. It is well known that asymmetrical ketones are produced by the dry distillation of mixtures of salts of two different acids, but the mechanism of the reaction has not been made out The hypothesis of an intermediate phase, the anhydride of the organic acid, is put forward The exchange of alkyl and aryl groups between a mixture of ketones at a high temperature does not appear to take place, but the acid anhydrides can, under the conditions of these reactions, exchange their characteristic groups -Charles Prévost: The tautomerism of two dibromides of an erythrene hydrocarbon. The preparation of the hydrocarbon dusocrotyl in a state of purity is described Bromine gives two dibrom derivatives, only one of which can be isolated. Attempts to prepare the fully saturated tetra-brom derivative failed.—Albert Kirrmann: The a-bromaldehydes. The a-halogen aldehydes react as though they contained acid halides, even after a bisulphite purification.—M. Tiffeneau and Mlle Jean Lévy The affinity capacity of the p-tolyl radical.—P. Fallot and R. Bataller: The north-east edge of the Cretaceous massif of Bas-Aragon.—E. Tabesse: Magnetic measurements in the centre and west of France. A table of the measurements is given, reduced to Jan 1, 1922 The distribution of the magnetic elements is generally normal, except in the Civray region, where there appears to exist a strong anomaly, principally for the declination -P. Idrac: A self-recording apparatus for the oceanographic study of deep currents. The apparatus described has been used experimentally on the coasts of Cotentin It is specially intended for use on the Pourquoi-Pas? for studying the fluctuations of the currents in the English Channel and on the banks of Rockall and Porcupine.—Pierre Gavaudan: The origin and characters of the oil-bearing elements of Madotheca platiphylla.—A Ch. Hollande: The renovation of the epithelium of the middle intestine of the Egyptian cricket, Orthacanthacris (Acridium) ægypta—Alphonse Labbé: The existence of specialised branchia in some copepods — M. and Mme Lapicque: The electrical reaction of plant cells and its relations with the excitability. A repetition of Waller's experiments that the blaze current is a sign of lesion; it is only a sign of life in so far as it marks the passage to death.—Mile M. L. Verrier: The

determination of the anatomical visual field in fishes and batrachians.—H. Labbé and A. Kotzareff: The action of mesothorium bromide on glycæmia in normal and cancerous mice.—Philippe Fabre: Neuro-muscular excitation by cuneiform waves.—Raymond-Hamet: The cardiac action of adrenaline during the stimulation of the vagus.—E. Roubaud. The eclosion of the egg and the stimulants of eclosion in the Stegomyia of yellow fever.—L. Lutz. The soluble ferments secreted by the hymenomycete fungi. Tannin as an antioxygen.—X Chahovitch, V. Arnovljevitch, and Mlle M Vichnjitch. The proteid sugar in various pathological states. Proteid hyperglycæmia is not a disorder specific to a disease, but is met with whenever there is some lack of nutrition and is the expression of the general metabolism changed by the influence of a non-specific agent.—A. T. Salimbeni and R. Sazerac: The action of bismuth on the spirochæte of Sodoku in the experimental infection of the guinea-pig.

#### ROME.

Royal National Academy of the Lincei, Mar. 20.— G. Fubini. The geometry of a surface in the projective group and in the conform group.—O. M. Corbino: Electrolysis without electrodes. In cases when electrolysis of a liquid is induced by an arc or an ionic discharge between an external electrode and the liquid, the lack of a metallic electrode not only changes the form of the cathodic deposit, which may assume the colloidal state, but also the chemical character of the electrolytic process may undergo modification. This is shown by the liberation of hydrogen rather than the deposition of metallic gold from a gilding bath.—A. L. Herrera: Growth and multiplication of artificial amœbæ. These structures, formed by drops of sodium hydroxide solution in a mixture of light petroleum and olive oil, are able to exhibit, although only to a limited degree, the phenomena of growth and multiplication, owing to increase of the osmotic pressure by absorption of fresh quantities of oil dissolved in petroleum through the soap membrane surrounding the alkaline drops.-E. Bompiani: Some general ideas for the differential study of [geometrical] varieties.—E. Bortolotti: Axial systems and connexions in  $V_m$ .—W. Blaschke: The linear element of Liouville.—G. Andreoli. Curvature and parallelism in a surface.—S. Cherubino: The integration of linear differential forms.—J. Dubourdieu: The holonomy groups of Riemann spaces of four dimensions. Case of an Einstein  $ds^2$ .—V. Hlavaty: Contact of two curves in a  $V_m$ .—L. Laboccetta: The analytical representation in finite form of the magnitudes expressed by different functions in arbitrarily assigned regions of the plane and of space.-N. Spampinato: Further contributions to the general theory of Riemann's matrices.—M. Pascal: Curves for the maximum (or minimum) thrust [aerial].—G. Todesco: Investigations on the accidental thermoelectricity of bismuth. Majorana's experiment with an amplifier and a thermionic valve demonstrated the possibility of obtaining a sound in a telephone connected with the amplifier if the latter is joined to a flat coil of high resistance having as nucleus a bismuth disc or ring, one of the faces of which is exposed to luminous radiation, periodically interrupted. The dissymmetries which cause this accidental thermo-electricity of bismuth are due merely to the fact that, in the crystallisation following fusion of the metal, the elementary crystals are disposed in the mass of the metal with varying orientation, contact of differently inclined crystals resulting in the formation of thermo-electric couples.-G. Piccardi:

Isotopy, excess weight, and atomic structure. According to a hypothesis previously advanced, an atomic species of number N and atomic weight P should possess (P-2N) positive electrons and (P-2N)negative electrons external to the atomic nucleus and arranged to form an electrically neutral whole. This hypothesis is now supported by the relations, manifested but as yet incompletely studied, between the atomic weight and (1) the difference between the weights of the lowest and highest isotopes, or the field of variability of the isotopes, for each element, and (2) the maximum excess weight exhibited by any group of isotopes.-D. Bigiavi: Relations between aromatic nitro-derivatives and azoxy-compounds. Evidence is adduced which confirms the reluctance to undergo substitution exhibited by the aromatic nucleus contiguous to the pentavalent nitrogen of the azoxy-compounds, and moreover shows that, in general, the presence in the aromatic nucleus of an azoderivative of nitro-groups in the para- or orthoposition to the azo-grouping renders difficult the addition of oxygen to a nitrogen atom of the azo-group by means of peracetic acid.—G. Malquori: The system  $\mathrm{Al}(\mathrm{NO_3})_3$ .  $\mathrm{KNO_3}:\mathrm{H_2O}$  at 25°. The isotherm of this system for the temperature 25° fails to indicate the formation of an additive compound between the two nitrates.-P. Pasquini: Homeoplastic grafting of the ocular rudiments in embryos of Pleurodeles Waltli.-R. Savelli: Lack of confirmation of the Giglio-Tos 'rational laws' on hybridism.

### Official Publications Received.

The British Institute of Philosophical Studies Annual Report and Statement of Accounts for the Year ended 31st March 1927 Pp 19

Report of the Director of the Royal Observatory, Hong Kong, for the Year 1926 Pp 19 (Hong Kong) Journal of the Chemical Society containing Papers communicated to the Society June Pp. x+iv+1221-1400. (London Guiney and

Jackson.)
The Plan of the Educational Colonies Association (of Great Britain and India): the Substance of a Series of Lectures on the Plan delivered in the Universities of Calcutta, Madras and Dacca By J. A Petavel. Pp. xl+288. (Calcutta: Educational Colonies Association)
Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 2, No. 3, June Pp. 199-288. (Cambridge Atthe University Press.) 12s. 6d net Board of Education. Report of H. M. Inspectors on the Provision of Instruction in Pure Chemistry in Technical Colleges and Schools in England. Pp. 11. (London H. M. Stationery Office.) 3d. net.

The Tea Research Institute of Ceylon Bulletin No. 1 Annual Report for the Year 1926. Pp. 29. (Kandy, Ceylon)
Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty, for the Year 1926. Pp. 10. (Cape of Good Hope.)

Secretary of the Admiralty, for the Year 1920. Pp. 10. (Cape of Cooking Hope.)

Forestry Commission Seventh Annual Report of the Forestry Commissioners, Year ending September 30th, 1926 Pp 45. (London: H.M. Stationery Office.) 1s. net.

The Physical Society Proceedings, Vol. 39, Part 4, June 15. Pp 251-874 (London: Fleetway Press, Ltd.) 6s net

South Australia Department of Mines. Mining Review for the Half-Year ended December 31st, 1926. (No. 45) Pp 105+7 plates. (Adelaide R. E. E. Rogers.)

### FOREIGN

Foreign

Proceedings of the Academy of Natural Sciences of Philadelphia A Revision of the Nemaboles of the Leidy Collections By Arthur C. Walton Pp 49-103+plates 410 The Structure and Affinities of Humboldtiana and related Helicid Genera of Mexico and Texas. By Henry A Pilsbry' Pp 105-192+plates 11-14 (Philadelphia, Pa.)

The Carnegie Foundation for the Advancement of Teaching. Bulletin No 19. Dental Education in the United States and Canada A Report to the Carnegie Foundation for the Advancement of Teaching. By William J Fies. Pp vxi+692 Bulletin No 20 The Quality of the Educational Process in the United States and Europe. By William S. Learned. Pp x+133 (New York)

The Rockefeller Institute for Medical Research. Organization and Equipment. Pp 24 (New York).

Proceedings of the United States National Museum. Vol. 71, Art. 12 Megachilid Bees from Bolivia collected by the Mulford Biological Expedition, 1821-1022. By T. D. A. Cockerell. (No 2684). Pp. 22 (Washington, D.C. Government Printing Office).

Index to Bulletin of the Geological Institution of the University of Upsala. Edited by Hj. Sugren. Vols. 11-20 (1912-1927), with lan Appendix containing List of Exchanges, etc. Pp. 43 (Uppsala Almquist and Wiksells Boktrycker A.-B.)

The Cambridge Bulletin No 57, June Pp 32+8 plates (Cambridge At the University Press)
Mr Murray's Quarterly Inst. July. Pp 32 (London John

Murray)
Microscopical Preparations Zoological and Botanical Material
Catalogue (A.) Seventh edition Pp 90 (Manchester Flatters and Catalogue 'A' Garnett, Ltd )

Garnett, Ltd.)
Catalogue of BDH Fine Chemical Products July Pp 10s
(London The British Drug Houses, Ltd.)
Laboratory Apparatus and Equipment Fourteenth edition Pp
151 (London Brown and Son (Alembie Works), Ltd.)
A Catalogue of Important and Rare Books on Botany, Agriculture,
Forestry, Frint-Culture, Gardens and Gardening, Herbals, Early and
Modern Medicine and Surgery, Tobacco (No 40°) Pp 144 (London
Ra ard Onaritch, Ltd.) 15 Ba ard Quaritch, Ltd ) 1,

### Diary of Societies.

SATURDAY, JULY 23.

SATURDAY, July 23.

Physiological Society (in Physiological Laboratory, Edunburgh), at 10 AM—Communications from 10 to 1—Dr B A McSwiney Structure and Movements of the Cardia—C W Greene Unique Characteristics of the Electrogram of the Isolated and Automatically Contracting Uterus of the Rat—C H Greene, Martha Aldrich, and L G Rowntree Studies in the Metabolism of the Bile Acids—R W Gerard The Metabolism of Peripheral Nerve—A J Clark and A C White The Action of Acetyl Cholme on the Cardiac Frequency and the Blood Pressure of the Cat—H Diyerre (a) The Effect of the Intermittent Injection of Adrenaline on Peripheral Nerve—Ab J Clark and A C White The Action of Adrenaline on Peripheral Rate, (b) The Effect of Ingestion of Calcium Chloride on the 19th of Urine.—W P Kennedy The Deflection of the Arneth Count by Radiation—J D S Cameron The Effect of Ingestion of Creatinine on Blood and Urine-Creatinine—Sir E. Sharpey-Schafer Further Observations on the Effect of Section of Cutaneous Nerves—E Ponder. Hematocrite Method of Determining the Volume of the Red Cell—O Meyerhof, A Communication—H E Magee and A E Gleinne Effect of Ether Anæsthesia on some Blood Constituents (Preliminary Communication.)—R Brinkman Registration of 19H of Circulating Blood by Means of the Antimony Electrode.—Demonstrations from 2 to 4—(a) A Method for Showing Continuous Tracings on the Screen; (b) A Simple Adjustment to deliver Make Induction Shocks, by N. E. Condon—The Measurement of the Red Cells of Man before and after Exercise, by H. Dryerre, W. G. Miller, and E. Ponder.—The Estimation of 19H of Fæces, by H. Dryerre, —Precipitation and Protection of Silver Sols, by W. W. Taylor—The Estimation and Protection of Silver Sols, by W. W. Taylor—The Estimation and Protection of Silver Sols, by W. W. Taylor—The Estimation of Percentage Hemolysis by the Selennum Cell, by E. Ponder.—Hemolysis by Ultra-violet Light, by W. P. Kennedy—Autolytic Changes in Lymph and Blood, by J. Lorrain Smith and T. Rettie—Apparent Cilia on the Epithelium of the Intertine

$$\mathrm{R}~\mathrm{Q} = \frac{x - 0.03}{20.93 \left(\frac{10}{79} \frac{v - y}{04}\right) - y},$$

where x is the % CO2 and y that of O2 in the expired Air, by W A M.

### MONDAY, JULY 25

CAMBRIDGE PHILOSOPHICAL SOCIETY (In Cavendish Laboratory), at 4 30—E G Dymond Excitation by High Velocity Electrons—ID. I. II Thomas The Production of Characteristic X-rays by Electronic Impact—Dr. W L Webster The Hall Effect in Single Crystals of Iron—C E Wynn-Williams A Valve Amplifier for Ionisation Currents—To be communicated by title only—J B & B Haldane (a) A Mathematical Theory of Natural and Artificial Selection—Pait V. Selection and Mutation, (b) The Comparative Genetics of Colour in Rodents and Carnivora.—S Pollard On the Generalisations of the Theorems of Parseval and Riesz Fischer—F. W. Carter Eddy Currents in Thin Circular Cylinders of Uniform Conductivity due to Periodically Changing Magnetic Fields, in Two Dimensions.—J. II Grace (a) A Theorem of Dr. P. Zeeman, (b) The Pedal Planes of a Tetrahedron, (c) An Illustration of the Space Representation of Circles—Miss M E. Grinshaw Summation of the Integral Conjugate to the Fourier Integral of Finite Type.—F. S Russell The Vertical Distribution of Plankton in the Sea—A. Lipschutz On Some Fundamental Laws of Ovarian Dynamics

### CONGRESS.

JULY 26 TO 28

BRITISH-AMERICAN NEUROLOGICAL MEFTING—Combined Meeting of the Neurological Section of the Royal Society of Medicine and of the American Neurological Association (at Royal Society of Medicine, i Wimpole Street, W 1)

Tuesday, July 26, at 9 30 A M — Short Papers.
At 2 P M — Short Papers

Wednesday, July 27, at 930 AM — Drs. F. Tilney, II. A. Riley, L. J. Pollock, L. E. Davis, A. J. Mussen, T. H. Weisenburg, and Harvey Cushing. Discussion on the Cerebellum.

At 2 30 P M - Special Clinical Meeting

Thursday, July 28, at 9 30 A m — Drs J S B Stopfold, W. Harris, S A. K Wilson, and Gordon Holmes Discussion on Sensory Disorders in Organic Disease of the Nervous System

At 2 P M — Papers and Demonstrations on Pathological Subjects. At 5 P M.—Dr. C L Dana The Hughlings Jackson Lecture



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## Pure Chemistry: a Report and its Implications.

FROM time to time in these columns the necessity for a new orientation of educational thought has been stressed. We have pointed to the changing intricacy of modern life—quickened, illuminated, ennobled, and enriched by the practical application of many sciences—and have frankly stated the view that, unless the new aspects and forces be deliberately woven into our educational schemes, those schemes are foredoomed to failure.

It is our business, however, sedulously to avoid being carried away by any theory which will not submit to all possible tests. All the many facets which a single problem may present must be taken into consideration. We do not imagine, for example, that one successful experiment necessarily presents a sound reason for sweeping and immediate alterations to some industrial process which rests upon conditions not always apparent in the laboratory

Such considerations compel us to realise that the educational changes we have in mind cannot be made impetuously. Time is necessary for the formation of professional no less than public opinion. Environmental factors need adaptation. If, for example, we have urged greater attention to technical education, not only as a sine qua non of industry but also as a vehicle of liberal qualities as yet but dimly apprehended, we have not failed to observe that its success is as much dependent upon its relationships with other forms of education and with industry as it is upon administrative method and teaching power. Is there any proof that advance in these directions is being made?

An encouraging answer is to be found in a Report 1 concerning the provision of chemical instruction in technical institutions, recently issued by the Board of Education. We congratulate the compilers on a brief and excellent piece of work. In the sober and guarded language of an official report, they have done something more than sketch out the volume and character of the provision of instruction in pure chemistry in English technical schools; they have done something more than set out important statistics and comment on the general standard of the work They have shown clearly the influence of factors upon which we have frequently insisted. They have presented undeniable evidence of definite advance as a result of those factors; and, in spite of their assertion

<sup>1</sup> Report of H M Inspectors on the Provision of Instruction in Pure Chemistry in the Technical Colleges and Schools in England. Pp 11. (London H M Stationery Office, 1927) 3d. net

that only pure chemistry is under review, they have, by implication, described the way of further development in other subjects

Notice the result of wider secondary education (in the full meaning of the term) and the growing appreciation of employers of the instruction available. It is now expected that, before admission to a full-time course a student should have received a secondary school education, though matriculation is not essential students entering part-time courses need not have been through the ordinary secondary school, but are expected either to have passed through a junior technical course consisting of mathematics, science, drawing, and English, or to show they have some knowledge of these This improvement is not due solely subjects to the wider provision of varying types of secondary education, but also to "the growing practice of employers in requiring that candidates for junior positions in their laboratories shall have received a superior type of education "

Well-organised evening courses, too, are playing a part which is of especial importance when it is noted that, of the 11,000 students taking instruction in pure chemistry, only about 15 per cent. are in full-time attendance (at 32 institutions). In 163 institutions, however, instruction is provided in part-time grouped courses. Insistence is now possible on an adequate standard of training preliminary to admission to evening junior technical courses. "As a consequence a higher standard of attainment is now secured in respect of an increasing number of part-time students"

Active interest on the part of employers and better preliminary training cannot, however, produce this higher standard of attainment unless administrative and co-ordinating factors also receive attention. By no means small have been the parts played by examination arrangements. "In the north-west the influence of the Union of Lancashire and Cheshire Institutes has been operative: in the midlands and the south the attraction of a University degree has been more important . . . in Pharmaceutical courses, the new requirements of the Pharmaceutical Society have increased both the numbers of students and the systematic character of their studies." This question of examinations—a vital function in the educational process is, in its wide implications, still under discussion in connexion with most branches of technical education, and there can be no doubt that the National Certificate schemes have gone far to satisfy supporters of the purely internal and of the purely external systems. Nor have examinations and new requirements fallen with dead and levelling weight upon the institutions "This degree of organisation has been secured without depriving the schools of their individuality"

If any more definite measurement of all-round improvement be necessary, the following extract can scarcely be bettered "A few years ago the proportion of students attending courses was probably not half what it is now The standard of admission was lower and less clearly defined, and a large number of students were entering upon the study of applied Chemistry with totally inadequate grounding in Pure Chemistry and with no previous or concurrent instruction in Physics" Now nearly eighty per cent of part-time students take courses involving attendance on three evenings per week and including the subsidiary subjects of mathematics and physics There is also a growing tendency to prepare for the associateship of the Institute of Chemistry in both full- and part-time courses

Though, however, the organisation may be excellent, the success of the work must ultimately rest upon the teacher—the final executive officer. In this connexion again the Report is soberly confident. The main work is in the hands of the permanent teachers of the technical school, who are assisted in the evening work by teachers who are employed in the day time in Secondary, Junior Technical or Central Schools, or in industry very large proportion of both groups possess graduate or equivalent qualifications general standard is therefore high, and is almost in itself a guarantee of the fullness and accuracy of the instruction" Some points of criticism arise, however, which give an indication of the special qualities which are needed in technical teaching—qualities not always found in teachers trained along the usual academic lines. "Some teachers who have had experience with young students cover the ground too slowly for the older students who attend evening classes, and they waste a good deal of time endeavouring to clicit conclusions from early and isolated experiments." The use of text-books, too, is not always understood. "Students need to be trained to acquire information for themselves, and the lecture hour is often more profitably devoted to emphasismo important points—creating perspective [our italics] -than in conveying information which can be obtained quite easily from a book"

A broad classification of 10,379 students for mg part-time courses is given. Within the chemical industry 2450 are engaged in laboratory

work, 1309 in the factory, and 651 in clerical or commercial work. 2324 are engaged in retail pharmacy and dispensing, while 3645 are absorbed by "other occupations" These figures give peculiar significance to another valuable point to which the Report directs attention In some schools "insufficient training is given in the simple laboratory operations The students have not enough practice in fitting up apparatus, and the importance of neatness and tidiness is not sufficiently impressed upon them" We have already noted a not dissimilar criticism in a speech made to the Association of Teachers in Technical Institutions by the ex-president of the Society of Chemical Industry (NATURE, June 25, p 942)

We hope in observing these defects we do not give any wrong impression We asked, at the outset, whether any proof was available concerning our own expressed views on the new factors which are slowly to change much current educational theory The Report provides us with adequate proof, and we shall bear its principles in mind in reviewing subjects other than chemistry In the meantime, so far as the latter is concerned, the crisp conclusion of the Report stands in need of no adornment "The teachers as a body are well qualified and generally competent, the accommodation and equipment are, on the whole, good, the organisation of most of the courses is satisfactory, and the defects to which attention has been drawn are the exception rather than the rule"

### X-Rays and Contemporary Physics.

- (1) X-Rays and Electrons. an Outline of Recent X-Ray Theory By Prof Arthur H Compton. Pp xv + 403 (London Macmillan and Co, Ltd, 1927) 25s net
- (2) Introduction to Contemporary Physics By Dr. Karl K Darrow Pp xxv1+456 (London. Macmillan and Co., Ltd, 1927) 25s net
- (1) THE rivalry of classical wave theory and modernist quantum theory has of late years dominated the physics of radiation, and in spite of all our efforts we can scarcely say that a really satisfactory solution is yet in sight where is the conflict more acute than in the field of X-rays, and the investigations of the past few years have all gone to emphasise the differences rather than to reconcile the warring interests. On one hand we have the establishment of what might be called the optical properties of X-rays,

through a prism, phenomena hitherto always explained in terms of the wave theory: on the other hand, quantum effects of an extreme type have been revealed by the study of the extraordinary effect known by the name of Compton, who first established that for very short X-rays, where the quantum of energy is large, the radiation can be shown to behave in many respects like a minute projectile, the results of whose impacts with an electron can be calculated on the lines of the impacts of massive spheres Prof Compton has also been closely interested in many problems which have been worked out in terms of the wave theory, such as the questions of the intensity of X-ray reflection and of X-ray absorption. His recent book on X-rays and electrons has therefore strong claims on our attention.

Prof Compton's book is, broadly speaking, devoted to the discussion of experiments and theories bearing on the physical nature of X-rays, and comparatively little is said of their applications either to the study of crystal structure or to practical questions such as the investigation of fibrous forms, organic or metallic. Much of the first part of the book is devoted to physical problems of which an explanation can be attempted in terms of classical electromagnetic theory, such as the polarisation of scattered X-rays, the intensity of X-rays reflected from crystals, and the more strictly optical properties of X-rays. Within the last few years, X-rays have been diffracted by ruled gratings, chiefly by Compton and Doan, and by Thibaud, and a striking photograph is given of a spectrum so obtained. Of course, the accuracy to be expected with this method does not so far approach that obtainable with ordinary crystal methods, but a value for the wave-length of molybdenum Ka has been obtained which agrees exactly with the crystal determination

A special chapter is devoted to the refraction, in the ordinary optical sense, of X-rays, and the small deviation from Bragg's law  $n\lambda = 2d \sin \theta$ , which has been experimentally detected, is explained in terms of the refractive index, which calculation shows to be slightly less than unity The total reflection at small glancing angles to be expected from such a value of the index, and the refraction by a prism of glass established by Siegbahn and others, are illustrated by excellent photographs. As Compton emphasises, the experimental determination of the refractive index affords a straightforward method of determining the total number such as reflection at a glass surface and refraction rof extranuclear electrons, and the value so found agrees closely with the atomic number. As is natural, the book contains full references to recent American work, such as Hewlett's repetition of Barkla's work on the scattering of soft X-rays which, on the basis of J. Thomson's classical theory, also gives very satisfactory values for the number of electrons in, for example, the carbon atom

The questions of the intensity of reflection of X-rays from crystals and the closely allied questions of absorption are treated in much greater detail than has so far been attempted in any book in The well-known work of W L Bragg and his collaborators, and the theoretical treatment of the whole problem by C G Darwin, are discussed at some length, and recent work by the author and his collaborators and other American workers, which is not yet widely known, is described Prof Compton has devoted much research to this part of the subject, and the various aspects of the somewhat complicated phenomenon of primary and secondary extinction come up for treatment. The distribution of electrons obtained by W. L Bragg and by the later American workers depends, of course, upon the laws of classical electrodynamics, and it is not established beyond doubt that they form a valid basis for such calculation.

The mability of the classical theory to explain the scattering of hard X-rays is well known, and Prof. Compton's account of his discovery of quantum scattering and the researches which have followed it, especially in America, will be eagerly read The quantum theory of the change of wavelength which accompanies the scattering of hard X-rays by 'free' electrons is very simple, and the general features—change of wave-length with angle of scattering, directed scattered quantum and recoil electrons—have been clearly confirmed by experiment. In this field the Wilson cloud chamber has proved its value as an instrument of investigation in a number of daring experiments. When we try to go a little farther, however, the initial simplicity is quickly succeeded by complications and difficulties The calculation of the broadening of the unmodified line demands some hypothesis as to the behaviour of the electrons within the atom, that is, we have to take into account the orbital motion of the electron at the moment when it is 'struck' by the quantum of radiation, and Jauncey's calculation on these lines is only partially satisfactory. The intensity of the scattered X-rays takes us still farther into doubtful and difficult fields. Here we may hope for the new quantum mechanics, out of which the

Compton effect comes so naturally, to give us some acceptable solution

The points mentioned are chosen from among some of the most interesting, and do not exhaust the scope of the book. There is, for example, a chapter on familiar lines dealing with X-rays and crystal structure, and another dealing with the elegant and less-known method of treating diffraction by a crystal from the quantum point of view.

The treatment in the book is largely mathematical, and greater attention is paid to the theories than to the description of experiments for example, the account of Compton and Simons' striking cloud experiment on the direction of the scattered quantum is very meagre, and less clear than the short description given by Kallmann and Mark in Ergebnisse der Naturwissenschaften. Naturally, the work of American investigators receives great prominence, to the relative exclusion of German work The work of the last few years is really the subject of the book, so that it often happens that partially unsolved problems and incomplete investigations are treated at great length. This actuality of the book will enhance its value to all those engaged in research in these difficult regions, but sometimes renders it tough reading

The general production is excellent, but it is unfortunate that the proof-reading has not been more carefully carried out. The literal misprints are many, but need not trouble the reader, as it requires, for example, little ingenuity to see in Naturious a reference to Naturunssenschaften, or to see that by  $I\lambda$  is meant  $I_{\lambda}$ . When it comes, however, to being referred back to Fig. 4.05 and finding that it means Fig 45; to page ix. 23, and having to discover that it means page 280 in chapter ix.; to page 22 when page 241 is meant. and so on, the reader grudges the waste of time. The index is incomplete even beyond the worst of indexes, and may give a false idea of the scope of the book: for example, the names of Dirac, Kuhlenkampff, Ishino, and many other workers do not occur in it, although there are references to their work in the book. These blemishes, however, are minor defects, which should not damp our appreciation of a book in which a great investigator gives an account of some of the most striking recent investigations in physics, of which he himself has been a great part.

(2) The reports on contemporary advances in physics, published by Dr Darrow in the *Bell System Technical Journal*, and distributed in separate form, are known to many physicists:

Dr Darrow, who is a member of the staff of the Bell Telephone Laboratories, has now brought out a book based on them. The "Contemporary Physics" of the title refers to what may be called the physics of atoms and rays, and no attempt is made to cover the whole field of physics Within the range chosen, Dr Darrow has made an excellent selection of material, which includes much important American work not hitherto quoted in text-books. The disconnected nature of the original articles, each of which referred to some one topical branch of investigation, has not been entirely eliminated in the book, so that we find some overlapping, and an order which must sometimes prove disconcerting Thus ionisation and radiation to the student potentials are discussed in Chapter vii, while clastic and inelastic impact are first defined in a subsequent chapter, and an account of Bohr's atom model is given still later The final chapter, which follows the epilogue, is a practically independent dissertation on the conduction of electricity through gases. The separate chapters make very interesting reading, for the author has picked out for treatment the phenomena on which attention is chiefly concentrated at the present time, and the book is embellished by a number of pertinent photographs illustrating various features , of modern work on spectra, which are not, however, very clearly reproduced in some cases

Dr. Darrow's book, like Prof. Compton's, serves to remind us of the enormous amount of purely scientific work now being carried on in great laboratories of America, both those of universities and those attached to great commercial concerns.

E. N. DA C. A.

### Yield Trials in Agriculture.

The Principles and Practice of Yield Trials. By F L Engledow and G Udny Yule. Pp. 78. (London The Empire Cotton Growing Corporation, 1926) 2s.

It is now nearly twenty years since a considerable number of agronomists in Great Britian have reached the opinion that agricultural field trials, whether concerned primarily with manures or with varieties, if they were to afford practical guidance to the farmer, must be carried out with increased precision. The important preliminary work of exploring the variability of yield by uniformity trials was performed for England in two excellent investigations by Wood and Stratton at Cambridge and by Mercer and Hall at Rothamsted. At about the same time, by what is not necessarily a co-

merdence, a fundamental advance in the theory of errors, which renders possible the exact treatment of the evidence of small samples, was made by that anonymous genius who disguises his identity under the pseudonym of "Student" Since that time the work of applying the knowledge gained to the practical refinement of agricultural experimentation has been actively carried on by Dr. Beaven at Warminster, and more recently in the Statistical and Field Department at Rothamsted, it would scarcely be an exaggeration to regard "Student" as the spiritual father of both developments

The recent memoir by F L Engledow and G Udny Yule on the Principles and Practice of Yield Trials" represents another case of the cooperation between the statistical and the experimental phases of the same large problem It is divided into two sections, of which the first includes an explanation of the statistical methods advocated, while the second deals with ' practical considerations and procedure." Commencing with Mercer and Hall's data in their uniformity trial with wheat, the reader receives a clear explanation of why an experiment, comparing the yields of single half-acre plots, may be expected to yield errors of the order of 5 per cent; and of how much higher accuracy is attained by utilising the same area under smaller replicated plots A statistical treatment is given for replicated plots, and a table of the normal distribution is provided and its use explained for finding the probability of exceeding by chance a given multiple of the standard error as estimated. Theoretical and practical limitations of the formula are then discussed, the principal of the latter being that ascribed to the differential response of varieties to climatic variations

In the second portion we do not hear so much of " practical considerations " as we might have hoped from the title, for the authors devote most of the available space, as they naively say, "to explain broad questions of policy," so that we are left much in the dark as to their opinions on many practical Only variety trials are discussed, and details these only with cereals The treatment is less systematic than that of the first part, and we are seldom allowed to forget, for more than a few paragraphs, how comparatively unimportant the author considers yield trials in general, and in particular the improvements in accuracy of which they are susceptible It is difficult to summarise this section. The first three portions seem designed to assert, at some length, that (i) varietal differences in quality are often more important than yield; (ii) qualitative differences should govern the choice of varieties for yield trials; (iii) the significance of yield-trial results is limited by their not being performed by industrial farm methods.

The fourth, fifth, and seventh portions are devoted to observation plots, an important subject, upon which the author speaks with authority, but which unfortunately can scarcely provide a preliminary opinion as to yield, much less a measure of it. Yield trials on the plan denoted 'chessboard 'are most carefully described; it should be noted that the author limits this extremely vague term to small trials carried out under a wire cage, with individual seeds dibbled at regular intervals, on a fine tilth; the 'plots' are about a yard square The reader of this portion will realise the force of the strictures previously developed upon the limited agricultural significance of trials, which depart from the methods of practical farming, but will wonder why no distinction was there made between 'chessboard' trials of this type and the betterknown methods of plot replication in the open field. A second valuable portion is the description of Beaven's half-drill strip method. Unfortunately, this is the only field method discussed. The last two portions on the size and arrangements of plots, and on 'corrections' for soil irregularities, have perhaps been hurriedly written, and without any very full consideration of the subject.

The authors have missed the fact that the method developed, following "Student," in Section I., is equivalent to a method of 'corrections' stigmatised on p. 75; as, indeed, is necessarily any method of eliminating a portion of the soil heterogeneity The fact also, that "Student" had shown eighteen years before that precise values of the probability may be obtained in tests of significance with small samples, is overlooked on p. 77, where it is asserted that "in agricultural work with a very small sample (e.g. of four or five observations) the value of P, however obtained, is quite untrustworthy." criticism should of course be confined to the methods here expounded; the great beauty of "Student's" treatment lies in the fact that it does give trustworthy tests of significance, within the scope of agricultural experimentation.

Apart from this omission, statistical criticisms will naturally be few. It appears unfortunate that in developing "Student's" method of treatment of a replicated experiment, the estimation of residual errors has been changed in such a way as to produce, in some cases, a serious under-estimate. A point, which is likely to be in some ways more misleading, lies in the use on p. 30 of the standard error appropriate to a pair of varieties chosen at random,

to test successive differences of a number of varieties set out in order of yield. This procedure is often grossly misleading, since the best and worst of a set of random yields from the same variety will often show 'significant' differences if tested in this way.

The curiously pessimistic tone as to the value of yield trials which influences both sections of the book is perhaps to be ascribed to a somewhat unexpected limitation of outlook as to the scientific purposes which such trials serve. After giving reasons for thinking that the differential response of varieties grown in different years may be so much as 5 per cent, a figure which the reviewer does not consider exaggerated, the authors continue (p. 33):

"In view of such results, it may well be asked, what is the value of these elaborate tests? The answer, though it may seem pessimistic to some, must be, we think, that it is very little or, if the phrase is preferred, extremely limited. Even in so far as the investigator is concerned with yield alone—and usually he is equally concerned with other qualities—he is concerned with the average relative yields over successive years."

It does not seem to have occurred to either author that a knowledge of these differential responses to weather or soil would itself be of extreme agricultural importance in the practical choice of varieties; and that such knowledge would do much to remove the real grievance of innumerable farmers who grow, for example, wheat in the west, or turnips in the south, of England, far from the centres of the industry, where research is properly concentrated. On the contrary, both effects are looked upon merely as 'errors' to be averaged out by interminable repetition. This same consideration of differential weather responses evidently also underlies the numerous passages decrying attempts to increase accuracy.

To adduce the importance of qualitative differences as a reason for neglecting accurate yield trials appears to the writer at least equally farfetched. After all, the demand for higher yielding varieties comes straight from the practical farmer, and, however difficult the experimenter may find it to attain adequate accuracy to meet this demand, it is a mere evasion of the difficulty to discant upon the importance, which no one denies, of qualitative differences. How the practical adviser is to weigh qualitative advantages against a loss of yield, or vice versa, without an accurate knowledge of the yield factor, is nowhere explained.

For these weaknesses it is probable that neither author would be to blame had the book been published either earlier or later by a few years; a few years ago, the theory on which the Latin Square

and other 'randomised' systems are based had not been developed, and in a few years' time the lessons learnt from their use, whether more or less favourable to these methods, will be sufficiently well known, even to writers without personal experience of their working At the moment they are in the difficult position of judging of the newer developments in experimental theory and technique, by the standards of an older theory and technique, the defects and inconsistencies of which it is the avowed purpose of the newer methods to correct. It is the paradox of the present situation that cotton growers overseas should be putting into practice the applications of just these newer theoretical developments, which their academic mentors would have them regard as impracticable

R. A. FISHER

# Physical Chemistry and Geological Problems.

Physico-Chemical Geology By Dr R H Rastall. Pp vii + 248 (London. Edward Arnold and Co., 1927.) 15s. net.

IN recent years the empirical descriptive methods of an older generative. of an older generation of petrologists have been fortified by exact experimental work in fields of high temperatures and pressures; and some knowledge of the more notable results that have been achieved, and of the fundamental principles of physical chemistry on which they are based, has now become an indispensable part of the equipment of a modern petrologist. The steady stream of publications from the Geophysical Laboratory at Washington, and from various European workers such as Vogt and Niggli, indicates the increasing importance of chemical thermodynamics in revealing the processes which rocks have undergone. Hitherto, however, there has not been in English any systematic introduction to physical chemistry in its application to geological problems. Dr. Rastall will earn the gratitude of a wide range of students by providing this excellent foundation for more extensive studies.

The first four chapters deal with the basal conceptions of equilibrium and the phase rule, and with the phenomena of fusion and solidification, solution and crystallisation, isomorphism and polymorphism. The principles having been clearly established and illustrated by cogent mineralogical examples, the author passes on to their application to igneous rocks. These are polycomponent systems, so complex that a satisfactory phase rule discussion is generally out of the question. Never-

theless, the ternary systems embraced in the group of components  $SiO_2$ —MgO—CaO— $Al_2O_3$ , and the systems albite-anorthite, diopside-plagioclase, and orthoclase-silica, all of which have been worked out fairly completely under anhydrous conditions, have made it possible to consider some of the simpler magmas and their cooling histories with very successful results.

Little is known as yet of the quantitative effects of volatile fluxes, though preliminary work in simple cases with water and carbon dioxide as the volatiles has already encouraged the geophysical workers at Washington to more ambitious attempts to conquer this difficult field. It is probably here that the most brilliant conquests will ultimately be made, for already Th. Vogt has shown that the pneumatolytic and hydrothermal stages in the cooling of a magma can be explained on physicochemical grounds. Moreover, increasing attention is now being given to the separation and transfer of gaseous phases as an active process in causing differentiation, facilitating assimilation, promoting metasomatism and concentrating ores. These topics are still largely confined to more or less speculative discussions of field observations, and, perhaps rightly in an elementary book, Dr. Rastall has touched on them but sparingly. His discussion of differentiation, however, clearly shows that, despite the work of Brögger, Harker, Bowen and many others, the mystery of the general problem still remains to be solved. Dr. Rastall puts his finger on the core of the difficulty when he writes: "There is no experimental evidence at all in support of the theory that a silicate melt tends to split into two conjugate solutions. Nevertheless many of the facts of Nature indicate pretty clearly that something of the sort does occur."

It is suggested that there is no justification for the recognition of the *spilitic* suite of rocks on the ground that its members differ from the 'true alkaline rocks' only in having soda in considerable excess of potash. But they appear in a totally different structural environment from typical alkaline rocks, and if Shand's clean-cut definition of the latter be accepted, then most spilites are not technically *alkaline* at all. The recognition of a *spilitic* suite should not be described as an attempt to confuse the issue (p. 95), rather, it is an attempt to clarify an issue that is at present excessively confused.

The integration of processes described as metamorphism is next treated. Here many mineral associations are clearly deducible from the phase rule; but where differential pressure has operated,

the natural conditions again rapidly pass out of the present scope of experimentation. Thermodynamic principles lead to the important deduction that differential pressure lowers the melting point. This curious fact, so remarkable to the beginner, has endless applications, and it is a disappointment to find it merely stated without a graphical demonstration.

Weathering is very properly separated from metamorphism, for its processes involve the reactions of aqueous solutions in an environment of low pressure and fluctuating but relatively low temperatures. Despite the apparent simplicity, the conditions are tantalisingly complex from the point of view of physical chemistry. The peculiar properties of surfaces, capillary spaces, and colloids (the last briefly treated in the final chapter) all require fuller investigation, and still further complication is introduced by the uncertain influence of bacterial activity

Little reference is made to the conditions that control the cementation of sediments and the growth of concretions. This is a subject that has been strangely neglected, and a systematic treatment in a book of this kind would be widely appreciated. The precipitation of saline deposits from surface waters is, on the other hand, a subject that has been thoroughly tidied up, thanks to the familiar investigations made by Van't Hoff and his colleagues. The results are briefly reviewed in a chapter on salt deposits, in which is also included an account of the origin, still vaguely understood, of the carbonate formations, including dolomite. The two remaining chapters are devoted to ore deposits and refractories and abrasives, branches of economic geology on which Dr Rastall speaks with the personal authority of a wide experience.

Dr. Rastall has skilfully avoided the tempting atmosphere of speculation. He has surveyed his subject with commendable restraint, and produced a clearly written and trustworthy book which reveals both the strength and the limitations of the methods of physical chemistry. To know that the natural interplay of energies in the earth is too complex for complete imitation is a mental tonic rather than a cause for depression. To know that laterite, dolomite, lamprophyres, and many another puzzling rock still present baffling problems to be solved, merely adds to their fascination; and when all is said, one feels, after considering the subject matter of this book, that Sederholm is thoroughly justified in his insistence that geology is very much more than applied physics and chemistry. ARTHUR HOLMES.

### Biological Philosophy.

Theoretical Biology. By J von Uexkull. Translated by Dr D. L. Mackinion (International Library of Psychology, Philosophy, and Scientific Method.) Pp. xvi + 362. (London · Kegan Paul and Co, Ltd, New York. Harcourt, Brace and Co, Inc., 1926) 18s net.

THE publishers of the International Library of Psychology, Philosophy, and Scientific Method are to be congratulated not only on the inclusion in their collection of this peculiarly interesting addition to biological thought, but also on securing the services of such an able translator Reference to Dr D L. Mackinnon's name on the title-page is necessary before the fact of translation is realised.

In this "Theoretical Biology," von Uexkull discusses modern biological concepts, and summarises them in relation to his extended application of Kantian philosophy to the animal world. Biological science has come to a deadlock by having been too greatly dominated by the physicist's insistence on an objective world, whereas the true secret of understanding is to be found not behind objects but subjects. The observer's viewpoint must of necessity be outside this subjective world, and when this fact is clearly realised, investigation can proceed

The mechanical processes of the organism reveal a conformation to a rule of Nature, which is not merely a mechanical law, but also indicates that there is a super-mechanical factor at work the production of a new framework, a process which takes place within every cell, repair proceeds from within. In a machine, this need for reconstruction must be dealt with from without, therefore here is an example of this super-mechanical factor, or 'impulse,' as von Uexkull calls it sion of a cell by impulses is always followed by the formation of a new framework, and consequently the impulses are referable to an influence exerted by the genes on the protoplasm. These impulsesystems are not regarded as a 'psychical worldfactor'-on the contrary, von Uexkull anticipates their isolation, since already there are indications that transference of form-giving impulses can take place. Thus they are part of an "objective conformity with plan," a biological doctrine into which "Lamarckism would pass straight over, would it but throw off its psychological wrappings." There is no question of 'purpose' or 'purposefulness,' as is generally understood by the idea of 'conformity with plan.' von Uexkull deplores the fact that the personification of Nature, which conception has occupied the minds of men for so long, cannot be dismissed once and for all from the realms of biological thought, and with it the inability to recognise "limits to the possibility of knowledge," so that full attention can be given to the acquisition of those positive additions to knowledge by means of which alone real progress can be made.

H. E. B.

### Enzymes.

Enzymes Properties, Distribution, Methods and Applications. By Prof. Selman A. Waksman and Prof Wilburt C. Davison. Pp. xii + 364. (London Baillière, Tindall and Cox, 1926) 25s. net.

THE authors of this book state that it has been their endeavour to collect in as concise a form as possible the available information in regard to enzymes and to indicate the original sources from which more detailed knowledge may be obtained. To piece these irregular and loosely fitting fragments together has been their object. Special attention has, they say, been paid to the occurrence and preparation of enzymes, to the methods of the measurement of their activity, and to the practical application of these agents

The text is divided into four sections, each of which is subdivided into chapters as follows.

(a) Properties of enzymes (four chapters); (b) distribution of enzymes (three chapters); (c) methods for the preparation and study, of enzymes (seven chapters); (d) practical application of enzyme activity (one chapter).

There is a bibliography giving references to 1323 original papers, none of which, however, is later than 1925. The book is brought to a close with an index.

The introductory chapter gives an outline of the history, general characteristics, nomenclature and classification of enzymes. The next three chapters deal with chemistry, biology, and physics. The major portion of the next chapter is devoted to the occurrence and distribution of enzymes in animal secretions and tissues. This is followed by two shorter chapters on the enzymes of the higher plants and of micro-organisms.

The section commencing with Chapter viii is the longest in the book, covering as it does 128 pages of text. Although containing some most useful information, clearly set forth and well arranged, it is here that we venture to make some criticism Under methods of measuring diastatic action, the authors describe Wohlgemuth's iodine method and Lintner's saccharometric method. In regard to the latter, a modification is described which is more complicated and does not appear to lead to

mcreased accuracy. No mention is made of the titration method devised by Prof. A. R. Ling, which has been adopted by the Institute of Brewing as one of the standard methods of malt analysis. Nor is there any mention that when the activity of malt diastase is measured by a saccharometric method, the production of reducing sugar must be kept within the limits laid down by Kjeldahl in 1879 if the results obtained with two or more samples are to stand in direct proportion.

In dealing with the synthetic action of enzymes, the work of Bourquelot-by far the most important on the subject—is not alluded to in the text. In that part of the book dealing with desmolasesoxidases, oxido-reductases, and zymases-sometimes the difference between supposed direct oxidase action and dehydrase action is described m a manner likely to prove misleading to the student. The authors make no reference to the discovery by Hopkins in 1921 of an autoxidisable constituent of the cell which he named glutathione, although they do refer to the significance in respiration of substances containing the thiol group SH which is present in reduced glutathione. Another serious omission is that of a reference to the recent work of Robison on the part played by calcium hexosephosphate and its enzyme on ossification and dentition.

If there are defects in the preceding parts of this book, there are more pronounced cases in the last chapter which deals with the uses of enzymes. Barley is said to absorb 40-50 per cent. of its weight of water in the steeping process—the first in the conversion of barley into malt. The fact is that barley after steeping contains about 50 per cent. of water. In describing the mashing process the temperatures given are 23°-13° C. too low for distillery practice and 26°-16° C. too low for brewery practice. The subject matter on the hydrolysis of starch by enzymes given in the book is out-ofdate, as is also that dealing with the estimation of starch by enzymes, and the latest methods adopted in England find no mention. These are only a few of the defects which could be cited.

We close our review with a feeling of disappointment Some portions of the book are such as to recommend it, whilst others show that the authors have omitted important observations or have failed to understand the true significance of some points to which they have referred. It is hoped that a new edition will be published in the near future in which the entire work will be recast, for the authors have not attained the objects which they set themselves to achieve.

### Our Bookshelf.

Practical Coal Production. Mine Transportation and Market Preparation: Mine Transportation, Hoisting and Hoisting Equipment, Coal Preparation. Compiled by Frank H. Kneeland. Pp vii +354. (New York: McGraw-Hill Book Co, Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 15s. net.

This volume is the third of the series of "Practical Coal Production" and may be looked upon as a continuation of the two previous ones, which have already been discussed in these columns. The present volume is no advance on its predecessors, showing quite as strongly as they do the defects previously indicated, and being perhaps even more scrappy' than either of the others. It contains three chapters, on mine transportation, hoisting and hoisting equipment, and coal preparation respectively. The first part consists of a miscellaneous collection of information concerning animal and locomotive transport underground; perhaps the best point about this section is the considerable attention paid to underground track work, the importance of which is just beginning to be recognised by colliery managers. Chapter ii. is almost wholly taken up by calculations, such important matters as the construction and design of cages and headgears not being even mentioned. Having regard to the recent developments in American coal mining, one would have expected to have found some information, at any rate, as to the employment of skips instead of cages, but this again has been entirely neglected. The third chapter is taken up mainly with coal conveying and screening. The author is aware of coal washing, but he dismisses it in a few lines, as though it were not in fact the most important part of coal preparation at the present day.

The author's lack of knowledge of what has been done in Great Britain again makes itself manifest at various points; thus he describes as an entirely novel invention screens, which he calls weightvibrated, being evidently unaware that the appliance he is describing is simply the old Beaumont vibromotor invented years ago in England. Whilst the book is well got up, misprints are more numerous than they should be. Perhaps the most noteworthy one is a caption on p. 3, "Insulting the Mule," when it is obvious from the context that the author

must have written "Insulating."

(1) Proceedings of the London Mathematical Society. Second Series. Vol. 25. Pp. 546. n.p.

(2) Journal of the London Mathematical Society.
 Vol. 1. Pp. 272. n.p.
 (London: Francis Hodgson, 1926.)

THE London Mathematical Society now issues its transactions in two volumes a year, the *Proceedings* and the *Journal*. Vol. 25 of the *Proceedings* contains 31 technical papers on various branches of mathematics read before the Society between March 1924 and January 1926. The high standard of recent issues is fully maintained, among the more

notable contents of this volume being Mr Chaundy's "Poncelet's Poristic Polygons," Prof Landau's "Zum Waringsche Problem," and Prof. Turnbull's "Invariant Theory of Mixed Quaternary Forms." Only a small number of papers deal with geometrical matters, an indication that most of the mathematical research now done in England is analytical rather than geometrical in character. Our only criticism is of the length of time, sometimes more than a year, which elapses between the reading of a paper and its appearance in the *Proceedings*.

Instead of the abstracts which have appeared in recent volumes of the Proceedings, the Society now issues a Journal, of which the first volume is before It contains records of the meetings held in the session 1925-6, three lectures given at meetings, and about fifty notes and short papers Prof Baker also contributes obituary notices of F. Klein and C. Segre, both being worthy tributes to the memory of distinguished mathematicians Of the lectures, Dr Glaisher's on the early history of the Society is the one of most interest to a general reader. Many of the short papers contain significant contributions to mathematical knowledge, Mr. Grace's "Point in Enumerative Geometry," Prof. Hobson's "Generalisation of a Theorem due to Riesz," and Prof. E. A. Milne's "Diffusion of Imprisoned Radiation through a Gas" being typical of many others showing marked progress in their respective fields. The publication of this new Journal has been rendered possible by the increased membership of the Society and also by the greater volume of noteworthy mathematical research produced in recent years. Either Journal or Proceedings can be obtained in parts as issued by non-members of the Society. W. E. H. B.

L'Atomisme d'Épicure. Par Dr Xénia Atanassiévitch. Pp. 111. (Paris: Les Presses universitaires de France, n d) n.p.

Dr. Atanassiévitch has written an interesting and well-documented study of the atomic theory of Epicurus, in which he maintains that, far from being a mere expounder of the theory of Leucippus and Democritus, Epicurus was responsible for the introduction of many new features. The number of fragments of Epicurus accessible to us is very limited, consisting mainly of a few letters, preserved for us by Diogenes Laertius, of which the authenticity is not established beyond doubt, but fortunately we possess what is probably a very faithful account of his theories in Lucretius' "De Rerum Natura." Leucippus, who is a merc name to us, and Democritus, whose work is also lost to us, supposed, according to their expounders, that atoms were indestructible and eternal, infinite in form and in number, and that everything arose from the collision of atoms in empty space. Epicurus denied that the atoms could have an infinite variety of forms, which agrees with our modern belief, and insisted that atoms had weight, which, according to Dr Atanassiévitch, was a property foreign to the atoms of Democritus. For Epicurus, then, atoms had size, shape, weight, and

velocity. Very interesting, in view of our modern theories, is the Epicurean doctrine. stressed by our present author, that, although atoms are physically indivisible, they have finite extension, and are to be considered as made up of small ultimate parts, minima. A chapter is consecrated to this doctrine of the minimum

It is very strange that, without any given experimental basis, often with ridiculous arguments—as when he cites spontaneous generation as a proof that atoms have no sensations—Epicurus should have arrived at a conception of the atom so similar in its essence to our present-day atoms built up of electrons. It would seem that there is something inherently attractive for the human mind not only in an atomic theory, but also in an atomic theory of a particular kind. Dr. Atanassiévitch's little book is well worthy of study by all interested in the history of scientific theories

E N DA C A.

Among the Kara-Korum Glaciers in 1925. By Jenny Visser-Hooft With contributions by Ph. C. Visser. Pp xii+303+25 plates. (London. Edward Arnold and Co, 1926) 21s net.

Kara-Korum is the name of a pass, yet it has been applied not only to the range containing the pass, but also to a tangled mass of mountains lying far to the west Exploration of this tangle has indicated that it consists of a series of ranges; so that the name Kara-Korum, as it is generally used, indicates a large district, rather than any particular range of mountains.

The area explored by Mr. and Mrs. Visser was limited to the headwaters of the Hunza River. The only way into most of the valleys lay through narrow gorges, occupied by rivers which were subject to sudden floods; so that the line of retreat was often closed for long periods. The party were actually imprisoned in this way in the Khunjirab valley, and were only saved from starvation by forcing their way over unknown glaciers and passes into the Shingshal valley. The glaciers in these valleys are unusually treacherous owing to the rapid melting of the ice under the tropical sun. Snow avalanches are common, but the greatest danger is caused by avalanches of stones. One such avalanche in the Hispar valley lasted

ducing the effect of a thick London fog.

The party successfully explored some of the largest glaciers in the world; the Batura glacier—37 miles of ice—and the chief glaciers in the Khunjirab and Shingshal valleys. The area traversed was mapped by Afraz. Gul Khan Sahib, whose services were lent by the Survey of India. Mrs Visser, who makes little of her own exploits, crossed glaciers and passes the existence of which was unknown even to the natives of the district. Two Swiss guides accompanied the explorers, and to their expert knowledge of ice, and its habits, the expedition probably owed its escape from the hourly dangers due to floods and avalanches

for many hours, and filled the air with dust, pro-

This book is illustrated by some excellent photographs.

The Scientific Feeding of Animals. By Prof. O Kellner. Authorised translation by Dr. William Goodwin. Second edition, revised Pp xiii +328 (London. Gerald Duckworth and Co., Ltd., 1926) 8s. 6d. net.

THE name of Kellner figures pre-emmently in the annals of the science of animal nutrition. Towards the end of the last century, at a time when little or no attention was being devoted in Great Britain to the elucidation of the scientific principles underlying the economic feeding of farm animals, Kellner was carrying out in Germany a series of classical researches which had the ultimate effect of raising the art of feeding to the level of a science. Indeed, the rapid progress which has been made in Great Britain during the last three decades in the development and application of the principles of feeding is, in large measure, a tribute to the excellence of Kellner's pioneer work.

Many students of animal nutrition science have had reason to feel grateful to Dr. Goodwin for the enthusiasm and initiative which led him, during the early years of the present century, to undertake the translation of Kellner's smaller text-book, Grundzuge der Futterungslehre" For many years this work stood unrivalled as a source of information to student, investigator, and farmer The welcome appearance of a new English edition has afforded Dr. Goodwin the opportunity of including the additional matter contained in the latest German edition, which has been revised and brought up-to-date by Prof. Fingerling, who succeeded Kellner at Mockern In particular, a new chapter on vitamins has been added. Despite these alterations, however, the book still remains, to quote Prof. Fingerling, "a masterpiece of H. E. WOODMAN. clearness and precision."

True Irish Ghost Stories. Compiled by Dr. St. John D. Seymour and Harry L. Neligan. Second edition, enlarged. Pp lxvii + 299. (Dublin: Hodges, Figgis and Co., London: Oxford University Press, 1926.) 7s. 6d. net.

The original collection of true Irish ghost stories appeared in 1914, and elicited a large number of additional examples which warranted a second and enlarged edition; but publication was delayed owing to the War. The re-issue is justified by the additions. The collection covers a wide range of phenomena. The three chapters which are devoted to haunted houses include some remarkable experiences, many of which are off the familiar track. One quoted from the Occult Review describes the apparition of what was clearly an elemental with characteristic hairless face and unpleasant stench. The poltergeist stories, as compared with some which have appeared recently in the Press in England, are, on the whole, disappointing as psychic manifestations, and indeed, except in the cases recorded by the late Sir W. Barrett, resemble folk-tales relating to these appearances rather than genuine experiences. Of the ancestral ghosts, some are already familiar to students of folklore, among them being the Gormanstown foxes, real foxes which on one occasion appeared

in Dublin itself There are several cases of invisible ghosts One, if invisible, was ponderable, for when it jumped on the handle bar of a bicycle the rider was compelled to pedal down a steep hill. Of apparitions before, at, and after death, and of the banshee, there are, as might be expected, numerous examples. The compilers present the stories without comment, and of course do not guarantee their genuineness.

Biological Relations of Optically Isomeric Substances By Prof. Arthur R Cushny (The Johns Hopkins University School of Medicine, the Charles E. Dohme Memorial Lectures, Third Course, 1925) Pp. vni+80 (London: Bailhère, Tindall and Cox, 1926.) 9s net.

In this short monograph the late Prof. Cushny has given an account of the pharmacological behaviour of those drugs which exist in an optically isomeric form. Starting from Pasteur's work on the separation of the two forms of tartanc acid by means of the differences in their crystalline form, the author describes how optical isomers can be separated by combining them with another substance which is itself optically active or by means of physical agents, such as heat, which in certain cases lead to the development of different properties by the two isomers. The relation of enzymes to optical isomers and the fate of the latter in the living tissues are then dealt with. Following a section on their pharmacological action, to our knowledge of which the author himself contributed by his researches, the final and most interesting chapter is devoted to some general aspects of this It appears probable that the specific activity of a drug depends on three factors. the general structure of the molecule, some special grouping, such as the alcoholic OH in the side chain of the acid in hyoscyamine, and, finally the presence of an asymmetric carbon atom. It is the latter which leads to a chemical combination between the drug and the cell, but it is on the second property that its specific action chiefly depends.

The Life of Buddha as Legend and History By Dr. Edward J. Thomas. (The History of Civilisation Series.) Pp. xxiv+297+4 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1927.) 12s. 6d. net.

Dr. Thomas makes a first-hand contribution to the subject, based on a wealth of new material; while at the same time he gives to the layman a fascinating biography of a personality mysterious and real, and, to the philosophic mind, perhaps the most attractive among all religious reformers. The account of Buddha's life in the first chapters provides perhaps the most interesting reading—as a story. The discussion of our literary sources of Buddhism in the introduction, and the analysis of the text in the appendix, allow the specialist and the scholar from the neighbouring fields of history and sociology to obtain a real glimpse into the foundations of our knowledge of Buddhism.

Most interesting and valuable, however, are the chapters discussing Buddhism as a religion and a

philosophy, in its kernel of history, and in its aura of myth. The last chapter, containing a comparison between Buddhism and Christianity, shows how, in the light of modern scholarship, most 'parallels' and 'borrowings' vanish. While Seydel found fifty parallels, van den Bergh was reduced to nine, E. V. Hopkins to five, Garbe to four, Charpentier to only one, and "other scholars reject all connexion." The dogma of diffusion which has become of late so fashionable in anthropology, tends to disappear from history, that is, from the discipline which has full means of proving or disproving diffusion

Recent Advances in Biochemistry. By John Pryde. Pp. viii + 348. (London · J and A Churchill, 1926) 12s 6d. net.

This excellent little book, a companion volume of "Recent Advances in Physiology," which we have already noticed in these columns, gives an up-todate account of our knowledge on certain selected biochemical problems It should be useful both to the advanced student and to the worker who wishes to keep abreast of his own subject in branches with which he may not be directly familiar, without the necessity of referring to the original work Apart from chapters on the biochemistry of the proteins, fats, and carbohydrates, interesting accounts are given of the biochemistry of phosphorus and sulphur compounds, of the vitamins, and of hæmoglobin and related pigments in each case the latest work, at the time of writing, has been included. The author has purposely omitted any account of the mechanisms of tissue oxidations and the chemistry of the internal secretions, since both have been dealt with in the companion volume. instead, he has included two extremely useful chapters on the chemical basis of specific immunological reactions and on chemotherapy, subjects which are not often included in text-books of biochemistry: they are, however, among the most interesting of those dealt with in this volume. We can confidently recommend this book to all those interested in this subject.

An Introductory Course of Mathematical Analysis. By Charles Walmsley. Pp x +293. (Cambridge: At the University Press, 1926) 15s. net.

Dr. Young in his preface to this book explains that it was written to meet the needs of first-year students at Aberystwyth, many of whom arrived entirely ignorant of trigonometry, while others were proposing to take mathematical honours. Only the university authorities can judge of the success with which this staggering problem has been solved, but Mr. Walmsley has evidently been more concerned with the latter class than with the former, and his work will probably be useful chiefly as an introduction to Hardy's "Pure Mathematics."

So far as it goes, the treatment is thorough and sound. special attention is paid to inequalities and inequations, and a good feature is the proof of the addition theorems for the trigonometrical functions defined by their series

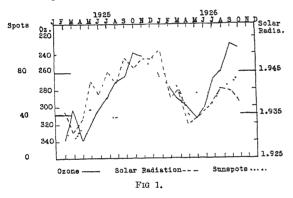
### Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE No notice is taken of anonymous communications.]

### Atmospheric Ozone and Solar Variability.

It has been known for a long time that variations in the annual mean values of the daily magnetic range were closely related to variations in the annual sunspot numbers. During recent months a number of other widely different terrestrial phenomena have been found correlated to some extent, at least, with solar changes and with each other.

Dr C G. Abbot has found that the monthly mean values of solar radiation show variations of the same character as do the monthly and annual sunspot numbers (US Monthly Weather Review, vol. 54. No. 5, May 1926). Mr. Greenleaf Pickard showed that there was a marked correlation between variations in sunspot numbers and radio reception at Newton, Massachusetts, and at Washington, D C. The companisons were made with wave-lengths of



8-9 megacycles. 15-25 kilocycles, and 1330 kilocycles. The measurements of the 8-9 megacycles and 1330 kilocycles were made at night, and those of the 15-25 kilocycles were made during daylight (Institute of Radio-Engineers, session of Jan. 10, 1927). Dr. L. W. Austin, of the U.S. Bureau of Standards, has shown that there is a strong correlation between the monthly means of radio receptivity and the monthly means of the Smithsonian measurements of solar radiation, and Dr. C. G. Abbot has found a marked relation between the total solar radiation and the ultra-violet radiation as measured by Dr. Pettit of the Mount Wilson Observatory. However, the variation in ultra-violet radiation is much larger, showing a range of about 60 per cent., while the total radiation shows a range of less than 5 per cent. (Smithsonian Miscellaneous Collections, vol. 80, No. 2, April 1927).

During the past two years Dr G. M. B. Dobson, Dr. D N. Harrison, and A. Lawrence, S.J., have made measurements of the amount of ozone in the earth's atmosphere at Oxford (*Proc. Roy. Soc.*, A, vol. 114; 1927). The monthly means of these values show an inverse relation to the monthly means of solar radiation as measured by the Smithsonian Institution and also to Dr. Wolfer's sunspot numbers. In the accompanying plot (Fig. 1) the continuous line shows the variations in the monthly means of ozone at Oxford, the broken curve shows the variations in solar radiation, and the dotted curve shows the variations in the monthly sunspot numbers.

The following table gives the departures of these three elements from the means of 19 months, using all the data available from Oxford The mean values are, for ozone, 0 284 cm of pure gas, sunspots 52, solar radiation, 1.940 gm cal per sq cm. per sec.

DEPARTURES FROM MEANS OF 19 MONTHS.

1925				1926			
	Ozone 1	Sun- spots	Solar Rad <sup>2</sup>		Ozone 1	Sun- spots	Solar Rad <sup>2</sup>
Feb Mar April May June July Aug Sept Oct Nov	+56 +20 +56 +37 +12 +15 -11 -18 -45 -37	$\begin{array}{c} -29 \\ -34 \\ -20 \\ -9 \\ -4 \\ -13 \\ -14 \\ +8 \\ +17 \\ +7 \end{array}$	$ \begin{array}{c} -4 \\ -9 \\ -7 \\ +3 \\ +4 \\ +5 \\ +8 \\ +8 \end{array} $	Feb Mar April May June July Aug Sept Oct Nov	$ \begin{array}{r} -6 \\ +6 \\ +5 \\ +20 \\ +17 \\ -18 \\ -26 \\ -56 \\ -52 \end{array} $	+17 +12 -13 +12 +20 -4 +11 +9 +26	$ \begin{array}{c} -1 \\ +1 \\ -7 \\ -6 \\ -3 \\ 0 \\ +2 \\ +2 \\ -2 \end{array} $

<sup>1</sup> Unit 0 001 cm

<sup>2</sup> Unit 0 001 gm. cal

From these numbers the correlation coefficient for ozone and sunspot numbers comes out,  $r = -0.62 \pm 0.09$ , and for ozone and solar radiation,  $r = -0.54 \pm 0.11$ . Presumably the correlation would be even higher with Dr Pettit's measurements of ultra-violet solar radiation, but the figures of his measurements are not at hand.

Dr Dobson and his associates believe that there is an annual period shown by the ozone measurements, and there probably is such a period, but its value cannot be determined from the data at hand; because while the ozone values decreased from about April to October in both years, it happens that the sunspot numbers and also the solar radiation values (both those of Abbot and Petint) increased from April to October in each year, and as there is an apparent negative correlation between these values and ozone at Oxford, it will take a number of years of observation to determine the terrestrial influence.

When the variations shown by the monthly means are eliminated and the day-to-day residuals are compared with sunspots, the relation between them is not evident. In 1925 the correlation coefficient was negative and in 1926 it was positive. But this result is not surprising. Dr. L. A. Bauer and C. R. Duvall found that the same thing was true of terrestrial magnetic variations (Terrestrial Magnetism and Atmospheric Electricity, Dec. 1925). The relation of these day-to-day magnetic variations to solar changes is different from that of the monthly means and its laws remain yet to be determined. In the case of solar radiation, the short period changes are connected in some way with the passage of spots with their accompanying clouds of calcium across the central part of the sun's disc, as I pointed out in Nature of Jan. 13, 1921, p. 630.

Dr. Dobson and his associates have shown that there is a very close relation between the day-to-day variations of ozone and the variations in pressure and temperature, more especially in the upper air. If future observations shall confirm the relation between the ozone values and variations in terrestrial magnetism and relate these to solar changes, they may furnish the key as to how solar radiation changes influence our atmosphere. Dr. Dobson has now established a network of stations for observing ozone, the preliminary results of which appear to show that there is an increase in the quantity of ozone and its variability from the tropics towards the pole. Since the ozone is found chiefly in the stratosphere, it may be that the increase of ozone with increase of latitude is associated with the increase in the depth

of the stratosphere which is found with increasing The increased depth of the stratosphere over areas of low pressure may also explain the increase of ozone with decrease of piessure in high latitudes

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### The Mechanism of the so-called 'Posterior Sucker' of a Simulium Larva.

IN NATURE of April 23, p. 599, there appears a letter from Dr. Sunder Lal Hora of the Indian Museum, Calcutta, on the subject of the mechanism of the so-called 'posterior sucker' of the Simulium larva, in which he describes the true method of progression of this remarkable larva. In the course of his remarks, Dr. Hora quotes a passage from Tonnoir (Ann Biol Lacustre, 11, pp 163-172; 1923) to the effect that this worker, "not finding any muscles inserted in the middle of the disc, doubted its utility as a true sucker and ascribed the function of attachment to the hooks alone" He then goes on to discuss Dr Puri's well-known paper (Parasitology, 17,

pp. 295-369, 1925). Mr. Tonnoir worked at the life-histories of New Zealand Simuludæ during part of his two years' tenure of a research studentship at this institute, 1921-23, and the paper mentioned above contains some of his observations on the biology of Simulium larvæ. Apparently Dr. Hora has not understood the paper, but only made use of the last sentence in Section I., p. 165, as quoted by Dr. Puri, which is the least important of all Mr. Tonnoir's observations. The whole section, pp. 163-165, entitled "Progression et fixation des larves," deals very fully with the points raised in Dr. Hora's letter, and reaches exactly the same conclusions as he does, only they are given in more abundant detail and as the result of longer and closer studies of the larvæ in specially constructed running-water aquaria designed by Mr. Tonnoir himself

May I be allowed to quote, side by side, the two

sets of observations as briefly as possible:
(1) Tonnoir: "Les larves ne sont pas munies de rentouses, . . . il faut définitivement abandonner cette

théorie des ventouses tant postérieures qu'antérieures."

Hora. "the posterior appendage does not act as a sucker, but fixes itself with the help of hooks

(2) Tonnoir: "La larve fixe toujours, sans exception, l'extrémité postérieure de son corps exactement à l'endroit où se trouvait sa tête un instant auparavant, et, pendant le court instant où elle forme la boucle avec son corps, sa couronne de crochets postérieure (la soi-disant ventouse) vient toujours en contact avec sa bouche," "La larve dépose, avec sa bouche, une certaine quantité de matière glutineuse (dont elle forme ordinairement ses fils de soie) sur ces crochets postérieurs et sur le support; ainsi fixée solidement par l'extrémité postérieure, elle redresse ensuite son corps et l'étend. de toute sa longueur, en avant, pour se fixer au support par la bouche contre laquelle se trouvent appliqués les crochets terminaux de la fausse patte antérieure; elle ramène alors en avant en se pliant en U, son extrémité postérieure

et la série des mouvements se répète."

Hora: "These [the sucker-hooks] are capable of gripping firmly a cluster of silk threads (the sticky salivary secretion) which the animal secretes on the spot where it intends the posterior appendage to be fixed."

The only differences between the two accounts are

that Dr Hora supplements the lack of detail in his account by giving a figure of the tracks of the sticky secretion made by the larva, whereas Tonnour's detailed account makes a figure unnecessary.

The real difference in interpretation lies in the question of the muscles of the so-called 'posterior sucker.' In the larvæ of Blepharoceridæ, where true suckers are present, the muscles are of great strength, much stronger than the ordinary segmental muscles; this requirement is obvious, when one reflects that the vacuum is produced within the suction area by the long-continued contraction of these same muscles. The muscles of the 'posterior sucker' in Simulium larvæ, on the other hand, are much weaker than the segmental muscles, as Dr Puri's figure (pl vui. fig 10) clearly shows, and could not possibly accomplish this Tonnoir had the blepharocerid larva in function mind (on which he was also working at the time) when he wrote "il n'existe pas de faisceaux musculaires destinés à la formation de cette coupe"; he did not imply that no muscles existed, but only that no muscles strong enough existed. To call these muscles 'strong,' as Dr Hora does, seems to me misleading; they are strong enough to pull the disc from the sticky secretion, but, compared with the segmental muscles, and more especially with the sucker muscles of Blepharoceride, they should be described as 'weak'

The principal object of this letter is to show that Dr. Hora, by not carefully reading Mr Tonnoir's paper published four years earlier, has laid claim to a discovery which has been even more fully made and more beautifully described by a brilliant worker in this Institute R. J. TILLYARD

Biological Department, Cawthron Institute, Nelson, N.Z., May 31.

### Radiation of Stars and Thermodynamical Fluctuations.

ACCORDING to modern views the substance of the sun and stars is in a state closely approximating to that of a perfect gas. These spherical gaseous bodies have been extensively studied on the basis of classical thermodynamics. It can scarcely be doubted that the internal layers of a star are in an almost perfect thermodynamical equilibrium having a radiative character, as has been convincingly established by Eddington.

It is only in the close proximity of the surface that considerable deviations from this state of equilibrium can occur.

In this note I wish to suggest that the theory of the stars may be greatly enlarged and improved by an introduction of a new agent, namely, thermodynamical fluctuations.

It is shown in statistical mechanics that the thermodynamical equilibrium is never absolute, there are always fluctuations, namely, irregular oscillations about a state of equilibrium.

When the system under examination is closed this state undergoes no change in the course of time. But a star must be regarded as an open system, which can exchange energy with surrounding bodies. In such a system the exact balance of fluctuations cannot exist either on the surface or in the deep interior. In these conditions the external radiation will appear as a necessary consequence of fluctuations.

The thermodynamical fluctuations may be of different kinds. The most important for our purpose are the fluctuations of emission and absorption. If E is the energy of full radiation contained in a volume

V, of frequencies corresponding to the interval  $\nu$ ,  $\nu+d\nu$ ;  $E_0$ , its mean value;  $\epsilon=E-E_0$ ;  $\overline{\epsilon}^2$ , the mean value of  $\epsilon^2$ ; h, Planck's constant, c, velocity of light, then

$$\overline{\epsilon^2} = h \nu E_0 + \frac{c^3}{8\pi \nu^2 d\nu} \frac{{E_0}^2}{V}.$$

The first term on the right side of this equation depends on the fluctuation of emission and absorption; the second term originates from the interference of rays crossing the volume V in all directions. Denoting the first part of  $\epsilon^{2}$  by  $\epsilon_{1}^{2}$  we have

$$\sqrt{\tilde{\epsilon_1}^2} = \sqrt{h\nu E_0}. \qquad . \qquad . \qquad . \qquad (1)$$

In what follows we shall apply this formula to the total radiation contained in a volume V, understanding by  $\nu$  a mean frequency. In certain elements of a star the quanta  $h\nu$  of energy are produced in an excessive number: in the other, it is the inverse process of absorption which predominates. The compensation of these two opposite processes is not complete with regard to the external radiation of the star Imagine the centres of increased emission and absorption irregularly disseminated throughout the total volume of the star; a part of the excessively emitted radiation gets free of the star into interstellar space. This is, I think, the mechanism of the external radiation of stars.

The exact computation of the resultant effect arising from fluctuations of emission and absorption in innumerable elements of a star seems to be a very difficult task. Much easier may be an approximate comparison of stars with respect to their external radiation considered as a shining due to fluctuations.

Let us admit that this radiation per unit volume is proportional to  $\sqrt{\epsilon_1^2}$ . In the formula (1)  $E_0$  is proportional to  $T^4$ ,  $\nu$  may be assumed proportional to T (absolute temperature), therefore, denoting by  $\sigma$  the energy externally radiated per unit mass of a star, we have

$$\sigma = \alpha \rho^{-1} T^{\frac{5}{2}}, \qquad . \qquad . \qquad . \qquad (2)$$

where  $\rho$  is the mean density, a a constant coefficient This law of radiation is no more than a rough approximation , nevertheless, it explains in a striking manner the diversity of the outflow of radiation per unit mass from different stars

Let us in the first instance compare the sun with Capella (the brighter component). The data necessary for us derived from astronomical observations are as follows:  $\sigma_{\text{Capella}} = 58$ ,  $\sigma_{\text{Sun}} = 1.9$ , whence  $\frac{\sigma_{\text{C}}}{\sigma_{\text{S}}} = 30.5$ ;

the density of the sun is 620 times that of Capella, the temperature is 43 times higher in the sun at corresponding points.

Eddington considers as a natural supposition that  $\sigma$  must be proportional to the density and to some higher than first power of temperature, say, second power. It follows that the quotient  $\sigma_{\rm C}/\sigma_{\rm S}$  should be about  $170\,070$ .

We have here, as Eddington points out, an "awkward paradox" (see "The Internal Constitu-

tion of the Stars," p. 397) Our formula (2) gives an explanation of the fact that with a smaller density is associated greater external radiative power; for the quotient  $\sigma_{\rm C}/\sigma_{\rm S}$  we obtain 16·2 instead of 30 5: the better agreement

might not be expected. We may also compare the sun with the variable star  $\delta$  Cephei. We have  $\frac{\sigma \delta_{\text{Cephei}}}{\sigma_{\text{Sun}}} = 55$ ; the density of the sun is 4120 times that of  $\delta$  Cephei, the tempera-

ture of the sun is 6 6 times higher. From formula (2) we obtain  $\frac{\sigma_{\delta C}}{\sigma_S} = 37$ . Thus the confrontation of theory and observational data provides a serious argument supporting the view that the external radiation of stars is a consequence of thermodynamical fluctuations

Further consideration of this subject will be found in a communication presented to the Polish Academy of Sciences on June 10, 1927.

Tcheslas Bialobjeski.

Warsaw, June 20.

## The Transition from Ordinary Dispersion into Compton Effect.

The dispersion formula of Kramers and Heisenberg is valid for an atomic system the dimensions of which are small compared with the wave-length of incident light. For very short waves the scattering from an atom will of course approach the Compton effect for free electrons; and this has been treated very fully by Dirac and Gordon. A treatment of dispersion theory on the basis of wave mechanics has been given by Schrodinger and Klein, who have also outlined a simple treatment of the Compton effect. Following a procedure rather analogous to that of Klein, it is possible to work out a generalised dispersion formula, holding also for waves short compared with atomic dimensions and making it possible to follow the gradual transformation of ordinary dispersion into the Compton effect.

For elements of low atomic number this transformation can be followed through various stages. The following brief account relates to an atom containing only one electron. During the first stage, while the wave-length of the radiation remains throughout long compared with atomic dimensions, its frequency varies from being of the same order as the characteristic frequencies of the atom to values large in comparison with these frequencies. The characteristic dispersion gradually transforms into the scattering, which must be expected on ordinary electrodynamics for free electrons, and which is given by the well-known formula of J J. Thomson. This formula holds approximately down to wavelengths approaching atomic dimensions. At that stage the scattering of coherent radiation will begin to diminish and will gradually be more and more concentrated in the direction of the incident light. Simultaneously with this effect, an incoherent radiation of frequencies equal to the difference between the incident frequency and the characteristic absorption frequencies of the atom will appear.

At first the intensity of this radiation will be mainly distributed over a few frequencies, the light of each component being scattered in all directions. As the wave-length decreases, the distribution of intensities amongst the various components of the scattered radiation will become more and more nearly a distribution which gives the well-known relationship between direction and frequency for the Compton effect, and also the intensity formula of Breit and Dirac. The phenomenon will have practically merged into the Compton effect when the momentum of a quantum of the incident light is large compared with the mean value of the momentum corresponding to the electronic motion in the atom. It is of interest to note that even at this stage the Thomson formula holds with a close approximation for the total intensity of the scattered light in any direction. This formula first ceases to hold approximately when the frequency displacement of the Compton effect is no longer small compared to the frequency of the incident light.

The mathematical discussion of the problem in question makes use of the fact that in the region where the frequency of the light is large compared with the natural frequencies of the atom, it is possible to calculate the scattering with high approximation directly from a knowledge of the wave functions of the undisturbed atom, the calculation being in this respect simpler than that of ordinary dispersion theory. It may be noted that the coherent part of the radiation is in this case directly calculated from that continuous distribution of electricity which is defined by Schrodinger's density distribution in the initial state of the atom.

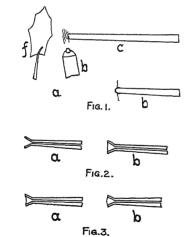
I wish to express my thanks to Prof. N. Bohr, Prof. C. G. Darwin, and Dr. O. Klein for their valuable interest in this work, of which a fuller account will be published shortly.

IVAR WALLER.

Copenhagen, Universitetets Institut for teoretisk Fysik, June 1.

#### The Mounting of Thin Glass Windows.

RECENTLY (early spring of 1926) it became desirable to produce a source of a-rays free from the disturbing effects of the accompanying emanation. This source was to be used in connexion with a simple a-ray track apparatus designed by the writer (Jour. Optical Society of Amer., vol. 11, No. 2, Aug. 1925; Science, vol. 64, No. 1649, Aug. 6, 1926). The solution came from a suggestion by one of the writer's students, L. P. Garner, a graduate in electrical engineering, University of Illinois, and for the above purpose leaves nothing to be desired Briefly it is as follows. A cane c (Fig. 1) of solid glass (Pyrex or Monax) is broken off squarely. On the centre of this end is placed a



minute film of dilute shellac, which serves to hold a microscopic quantity of radioactive salt (radium bromide was used). Now prepare a film f by blowing it out of the same glass and so thin that it will show Newton's rings. Hold this film with a pair of forceps in front of and distant about  $\frac{3}{4}$  inch from the tip of the cane bearing the radioactive salt and bring them up to a soft blast b, as shown in Fig. 1, a. Heat carefully, and as soon as the square tip begins to assume a globular form thrust it through the film f. The result is a varnish of glass, as it were, enveloping the front side of the globule as shown in Fig. 1, b. The burr is now brushed off and the emanationless source of a-rays is ready for use, providing no mishap was encountered.

A step further in the process is the fusing on of glass windows This has been carried out during the past few months at the Cavendish Laboratory. Figs. 2 and 3 show the essential steps The cavity on which the window is to be fused should be prepared with care, the lip should be square and symmetrical, and the glass walls should be rather heavy. Best results will be secured by the beginner if the opening of the cavity to be glazed be not more than 2 mm. inside diameter. The capillary leading to the cavity may have, of course, any dimension desired. If a plane window is desired the capillary must not be obstructed during the operation. The procedure is the same as for the solid cane. Care must be taken not to overheat the edge of the cavity or else it may become deformed; also this hot edge when thrust through the film f must strike it squarely—an operation that succeeds after several trials. Windows of 005 mm thickness and 2 mm diameter will withstand a vacuum either in or out.

A much thinner film of glass may be used for a given diameter of window if it is fused on concave or convex, as shown in Fig. 3, a and b. The process after all is very simple. To produce a concave window attach the capillary cane to an aspirator stopped down to produce an exceedingly small suction, and proceed as above. The amount of concavity produced is readily regulated by adjusting the suction. Again, to form a convex window it is only necessary to close the capillary with a little soft wax while fusing it on. The expanding air within will give it the desired convexity. A few trials may be necessary. When successfully done these fused junctions are vacuum tight and present a beautiful appearance under a magnifying glass.

Windows thus fused on should prove useful in a

number of researches with a-rays.

CHAS. T. KNIPP.

Cavendish Laboratory, Cambridge, June 30.

#### Modern Photometry.

I WISH to clarify a somewhat confused account of some work of mine given in Walsh's "Photometry," pp 244-245 (London: Constable, 1926). Since the same mistake has also been made by others heretofore and bids fair to become prevalent, it seems desirable to publish a correction. I do this not for the sake of finding fault, but to prevent, in so far as possible, the continued spread of mistaken ideas in regard to the subject matter in question. It is well known how errors once incorporated in a standard text are copied and re-copied without limit.

The error in question is that the instrument designated by Dr. Walsh as "The Leucoscope" is not the leucoscope, but the "rotatory dispersion colorimetric photometer." The pertinent facts are as follows:

(1) The leucoscope is an instrument the invention of which is commonly attributed to Helmholtz, about 1870–80. There has been some slight controversy as to the relative contributions of Helmholtz, and one of his pupils, Diro Kitao, to its development Edm. Rose (1863) described an instrument which may be regarded as the prototype of the leucoscope A review of the history of the instrument and a full bibliography have been published in my paper on the leucoscope (Jour. Op. Soc Am., 4, 448-495; 1920). It consists essentially of a quartz plate between a Wollaston prism and a nicol prism through which the observer views two images of the same source.

(2) The instrument which Dr. Walsh describes and calls "The Leucoscope" is properly called the "rotatory dispersion colorimetric photometer" (J.O.S.A.

and R.S.I. 7, folded insert facing p. 1199; Dec. 1923). I particularly object to naming it "Priest's leucoscope" as is done in the index of Dr Walsh's book. It is a special form of the Arons' chromoscope (Leo Arons: Ann. der Phy (4), 39, 545-568; 1912), and its embryonic form may be seen in Zoellner's colorimeter (J C F. Zoellner: "Photometrie des Himmels," Berlin. 1861 G. Mueller: "Photometrie der Gestirne," pp 244-254; Leipzig, 1897) My connexion with this instrument has been to develop the theory and practice of its use in the colorimetry and photometry of incandescent sources and daylight, and to design an instrument especially suited to these purposes.

(3) In principle, manner of use, and specific purpose served, the two instruments are very different. About all that they have in common is the fact that they both contain nicol prisms and quartz plates and the circumstance that I have written papers dealing with

each of them separately.

It seems unnecessary to occupy space by setting forth in detail the distinctions between these two instruments. All confusion may be removed by consulting my papers which deal respectively with the two different instruments, namely, "A New Study of the Leucoscope..." (J O.S.A., 4, pp. 448-495; Nov. 1920), and "Colorimetry and Photometry... by the Method of Rotatory Dispersion" (J O.S.A. and R.S.I., 7, pp. 1175-1209; Dec. 1923).

IRWIN G. PRIEST.

Department of Commerce, Bureau of Standards, Washington, June 21.

Mr. IRWIN G. PRIEST has been good enough to send me a copy of the above letter concerning the description, in my recent book "Photometry," of the instrument developed by him for heterochromatic

photometry (pp. 244-5).

While agreeing, of course, that his instrument is m no wise identical, either in principle or in use, with Helmholtz's 'Leucoscope,' it still appears to me that 'Leucoscope Photometer' is a not inappropriate description of the instrument, which is, in essence, a photometer in which a colour match is obtained by means of the rotatory dispersion of quartz, and a brightness match by means of polarisation prisms. Nevertheless, it is clear that as Mr. Priest is the inventor of the instrument, he must necessarily be entitled to object to having any name attached to it which, in his opinion, is liable to lead to misunderstanding. I can therefore assure him that should a further edition of my book be called for, the alteration will certainly be made. In the meantime I feel sure Mr. Priest will agree that the description of the instrument which I have given in the text of my book is in no way misleading.

John W. T. Walsh.
The National Physical Laboratory,
Teddington, Middlesex,
July 6.

## The Dissociation of Carbon Dioxide at High Temperatures.

WHEN mixtures of carbon monoxide and air in varying proportions are exploded in a closed vessel under similar initial conditions of pressure, temperature, and moisture content, experiments show that the greatest explosion pressure occurs when the proportion of carbon monoxide to oxygen in the mixtures is greater than 2. Messrs. Fenning and Tizard, in their paper on the dissociation of carbon dioxide at high

temperatures in a recent number of the *Proc. Roy. Soc.*, assume that chemical equilibrium is established by the time the maximum pressure is reached in explosions and attribute this phenomenon entirely to temperature dissociation of carbon dioxide. They then proceed to make estimates of the dissociation of carbon dioxide as a function of temperature from explosion experiments in which the 'airs' used were enriched with oxygen so as to develop higher temperatures.

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The assumption that chemical equilibrium is attained at the maximum pressure in explosions is, I believe, erroneous and dissociation values calculated from explosion experiments upon this basis

are much too high.

Some earlier experiments of mine in which measurements of heat loss were made during explosion convinced me that chemical equilibrium is not attained at maximum pressure—at any rate in explosions of complex mixtures like those of coal-gas and air. Recently we have been working in Leeds with pure gases (carbon monoxide and hydrogen) and have come to the conclusion that even with such gases chemical equilibrium is far from being attained at maximum pressure. One of the methods employed is, on the experimental side, precisely similar to that adopted by Messrs. Fenning and Tizard, but the range of our experiments is wider in that we have made investigations at explosion temperatures so low that dissociation is insignificant as well as at higher temperatures. Thus Mr. R. A. Smith, a research student, has experimented with carbon monoxide explosions, varying his 'airs' so as to investigate the temperature range 1600° C. to 3000° C. His experiments prove that the amount of uncombined gas at the maximum pressure in 'complete combustion mixtures' is at least 10 per cent. of the original charge when the explosion temperatures are below about 2000° C., but as the explosion temperatures are increased the amount of uncombined gas increases. The explanation would appear to be that below 2000° C. the uncombined gas is due to incomplete combustion and that above 2000° C. dissociation adds to this. It seems clear, then, that the assumption of chemical equilibrium at maximum pressure is unjustifiable.

Mr. Smth's explosion vessel consists of a sphere 6 inches in diameter, and the gaseous mixtures before explosion were at atmospheric temperature and density. Our work suggests the desirability of experimenting with vessels of various sizes and shapes and also at various densities, and we propose to arrange for this before publishing our results in detail.

W. T. David.

Engineering Department, The University, Leeds, July 16, 1927.

#### Polyploidy within a Species.

The importance of taking chromosome characters into consideration in the study of genetical problems is becoming increasingly more apparent, particularly in relation to the species problem, and any peculiarity in this respect requires careful attention. The study of large genera and of the occurrence of polyploidy within their limits, as exemplified by Rosa and other genera, has thrown considerable light on the origin and interrelationships of the various species. In investigating Silene and the neighbouring genera from this point of view, the actual base number of chromosomes is itself of considerable interest, since in Saponaria and Dianthus it may be 14 or 15, whereas in Silene, etc., it is invariably 12. So far, however it is these latter genera, Silene, Melandrium, Lychnis,

etc., which have chiefly occupied my attention, and it appeared, at first, as if the question of polyploidy scarcely arose at all; even now, after the investigation of more than sixty species, only seven have been found to be other than diploid. Among these, however, one, Silene ciliata, has shown itself of such exceptional interest that it seemed to me worth while directing special attention to it In the genus Silene, although more than thirty species have been examined, only two show polyploidy of these S vallesia is a normal tetraploid, whilst in the case of S ciliata I have investigated two races, one of which is tetraploid and the other has a haploid count of 96 and is therefore 16-ploid. The plants of this latter race were perfectly normal in chromosome behaviour and fertile. The two races were obtained from different sources and both were quite typical, and this within a species which is somewhat variable.

Although cases are known in which tetraploidy does not produce a 'gigas' form, it does seem somewhat surprising that a race can alise with four times the normal number of chromosomes, and with actually the largest but one recorded figure for angiosperms, and yet show no obvious difference in appearance.

That this is a case of continuous duplication of chromosomes rather than segmentation of the individual chromosomes is strongly suggested by the observation that the size of the chromosomes is little less in the case of the 16-ploid race; even the characteristic ring shape at the heterotype division is retained. The volume of the pollen mother-cell in the two forms is very little different, that of the tetraploid being about three-quarters that of the 16-ploid. The chief difference in cytological appearance is due to the extremely close packing of the chromosomes in the latter case.

This record seems to minimise the value which has frequently been attached to mere multiplication of chromosome sets and, at any rate within the limits of the Silenoideæ, to emphasise the importance of the original set characteristic of the genus

KATHLEEN B. BLACKBURN. Armstrong College (University of Durham), Newcastle-upon-Tyne, July 4.

### Optical Behaviour of Protein Solutions.

A VERY remarkable increase in light-scattering power is exhibited by gelatine solutions when the hydrogen-ion concentration approaches the value (about pH = 5) corresponding to the iso-electric point. This effect, which appears to have been known for some time, has been recently studied in detail by Kraemer and his co-workers, who give interesting curves showing the manner in which the Tyndall effect varies with  $p{\bf H}$  and temperature ("Colloid Symposium Monograph," vol. 4, and Journal of Physical Chemistry, May 1927).

The phenomena are scarcely intelligible on the view commonly adopted that the Tyndall effect in a colloidal solution is simply proportional to the number of scattering particles of the same kind present in it. Their explanation becomes clearer if we apply to colloidal solutions the general thermodynamic theory of light scattering, in which the Tyndall effect is regarded as due to local fluctuations of optical density in the medium. According to the latter theory, the scattering power of a colloidal solution would be connected with the osmotic pressure P of the particles, by the relation

 $rac{\pi^2 RT}{2N\lambda^4} rac{k(\hat{c}\epsilon/\hat{c}k)^2
ho/m}{\hat{c}P/\hat{c}k}$ ,

where k is the concentration of the dispersed material,  $\epsilon$  is the optical dielectric constant of the solution and

 $\rho/m$  is practically unity for a dilute solution. It is well known from the work of Jacques Loeb that the osmotic pressure of a gelatine solution alters in a notable manner with pH, becoming very small at the iso-electric point. Equation (1) then enables us to see at once why the Tyndall effect becomes very large under the same conditions.

A detailed discussion of colloidal optics on the basis of the thermodynamic theory of light scattering will be published in the Indian Journal of Physics C. V. RAMAN.

### The Relationship between Chinese and Arabic Alchemy.

SINCE my communication on the subject of Chinese alchemy (NATURE, Jan. 1, 1927) was written, I have received the very important memoir entitled "Chemistry in Iraq and Persia in the Tenth Century a D.," by Principal Stapleton, the late Mr. Azo, and Mr. M H. Husam, published in the Memoirs of the Asiatic Society of Bengal, vol 8, No 6, 1927. In this (p 405) the treatise on Taoist alchemy, Pao p'o tsz of Ko-Hung (A D 330), to which I referred, is mentioned, and a summary of the alchemical contents of three of the 'Inner chapters' (Nuy peen), translated from an edition published in 1884, is given. This information does not go further than that already published, and it would seem that the account given by Edkins is nearly complete. The authors then remark (p. 406) that: "The above account is sufficient to prove (a) that Chinese alchemy was concerned almost entirely with Mineral Chemistry: and (b) that Ko-Hung's materials were so extraordinarily similar to those used by Arabic and Greek alchemists that it is certain that Chinese, Greek, and Arabic alchemy must have had a common source of origin " They also refer (p. 405) to a further possible source of Arabic alchemy, namely, the Chinese School of Alchemy which was flourishing at least as early as 200 B.C'

It will be seen that the distinguished Oriental scholar has reached the same conclusion as myself: the only difference between us appears to be that he regards Chinese alchemy of 200 B.c as well established, whilst I consider that this still awaits satisfactory demonstration. An examination of the information dealing with this earliest period by a competent expert is still necessary. J. R PARTINGTON.

Kingsbury Close, London, N.W.9.

#### Fictitious Amazons.

The efforts of syndicated journalism to popularise research occasionally lead to misunderstandings. I have to-day received a cutting from the Daily Mail of Bombay, dated June 14, devoting two columns to discussion of views about the ancient Amazons, which I am represented as having maintained at a meeting of the British Association for the Advancement of Science. Will you give me the opportunity of saying that neither before the British Association nor before any other public body have I discussed the ancient Amazons at all. Similar announcements have been appearing in French, Belgian, and especially in American, papers during the past six months, in connexion with the Philadelphia meeting of the American Association last December. It is true that I attended that meeting as the representative of the British Association, and gave a public lecture on some aspects of the geography of Greek lands; but that lecture contained no reference to the Amazons.

Will Indian, French, Belgian, and especially American newspapers 'please copy'?

JOHN L. MYRES.

New College, Oxford, July 19.

### The Resources and Applications of Manganese.

UR very material and complex civilisation, admittedly only rendered possible by the developments in metallurgy, is indebted to the chemists of the eighteenth and early nineteenth centuries to an extent not always appreciated for their success in isolating the elements, and particularly the metals Their efforts were largely sustained by the desire for knowledge, since material reward in the modern sense could scarcely be contemplated, and, indeed, did not enter into the thoughts of many of these pioneer investigators. The world owes much to the Swedish chemist Gahn, who first successfully isolated the metal manganese in the latter half of the eighteenth century. As regards the application of the element in the metallurg of steel, the two outstanding names are Mushet and Hadfield Mushet discovered its value when added in small quantities in the manufacture of ordinary commercial steels, whilst Hadfield produced an alloy of iron and manganese having properties entirely new and unsuspected in the range of ferrous metallurgy. Hadfield's manganese steel led the way in the successful development of alloy steels This material, when quenched in water from a high temperature, becomes soft and tough, whereas previous steels became hardened by such treatment. By virtue of the discovery of such phenomena, investigators were led into a proper appreciation of the changes taking place in iron and steel with change in temperature Sir Robert Hadfield we are indebted for two extremely interesting papers presented at the May meeting of the Iron and Steel Institute reviewing the world's resources of manganese, the other containing the results of his latest researches on the iron-manganese-carbon system. It is of value that an investigator who over a long life of continuous research in a field which he has made peculiarly his own, should review the sub-

When it is remembered that manganese was only first isolated in 1774, the metallurgical achievement at the present time of smelting  $2\frac{1}{2}$  to 3 million tons of ore is indeed considerable. Such are, however, the advantages of the alloying of the metal with iron that it is indeed desirable to review the position, particularly in regard to the British metallurgical industries. In an interesting and valuable contribution to the discussion upon these particular papers, Sir Thomas Holland quite rightly asks whether, and to what extent, scientific and technical matters such as these should be confined in discussion to technical institutions, and whether the larger public should be instructed in the economic and political aspects of the matter. The discussion in which Sir Thomas took part undoubtedly gives the answer, since the extent of the resources and the distribution of the ores were brought home to a large audience, many of whom no doubt were instructed by the paper and the ensuing speeches. Particular attention might be directed to an excellent map given by Sir Robert Hadfield showing the known sources of manganese ore in relation to the British Empire, and whilst it is clear that we have excellent deposits within the Empire's borders, it is also clear that to retain the advantage of them, and to receive adequate supplies for the home industries, our sea routes must be kept open—India, the Gold Coast, Russia, and Brazil are indicated as the largest present sources of supply; large deposits not fully developed occur in South Africa, Europe, and South America, whilst there are few parts of the world where the ore is not worked—Cost, however, is vital, and the richest, more easily available, and the nearer the deposits, the better is it for the consuming industry

Turning to the commercial reduction of the metal from the ore, the survey of the development indicates rapid technical progress. The discovery of the influence of manganese in facilitating the production of good steel by Sir Henry Bessemer's process, naturally led to concentration upon the

matter of supplies of the metal

It is described how Heath in 1839 first made the application of manganese to steel production possible by the use of his carburet of manganese, but it should be remembered that at that date, and for some time afterwards, liquid steel could only be produced in small crucibles which men could lift. It was the advent of Bessemer's process, described by him in 1865, which made possible the engineers' dream of a mechanical world based on iron and steel Without manganese, the process was not practicable. Largely through the experiments of Mushet, who had been working at the production of metallic manganese from 1830 onwards, it was shown that the addition of manganese to Bessemer's blown metal produced a very tough workable steel, and ensured the commercial success of the process destined to revolutionise everything, since, for the first time, cheap steel in great quantities became possible for the multiplication of railways and ships, and a multitude of minor services upon which our civilisation is so dependent. By 1865, at the suggestion of Bessemer, Henderson in Glasgow was making an alloy of iron and manganese, containing 25 to 30 per cent. manganese, by his own process, which consisted of reducing, upon the hearth of a Siemens' furnace, 'a mixture of carbonate of manganese and oxide of iron in the presence of excess carbon by means of a neutral or reducing flame." M. Pourcel and his colleagues then developed in France the production of ironmanganese alloys, very rich in manganese, by blastfurnace methods, and such indeed was the progress during the years 1875 to 1885, that even during this period the alloy was available with more than 80 per cent. of manganese and produced at a price so low as to constitute an adequate complement to the economic side of Bessemer's process. Our British ironmasters were not slow to follow, and manganeseiron alloys of a wide range of composition became suitably available, both in quality and tonnage, to meet the needs of the rapid increase in steel production.

We now come to consider a most important phase

of the manganese production. Whether the alloy was ferro-manganese with a very high percentage of manganese, or 'Spiegel' containing low percentages of manganese, it necessarily contained a high percentage of carbon, owing to the fact that it was produced in the blast furnace with coke as the reducing agent. Manganese alloys were not available except with a high carbon content, and the carbon ranged at so high a value as 40 to 7.0 per cent. This was fortunate as regards the Bessemer process, since that process consisted, in Britain, of blowing air through liquid crude iron until finally only very small quantities of the carbon, manganese, and silicon remained, and therefore it was just as necessary to add carbon as manganese before finally casting the steel. Since the manganese addition of the order of 1.0 to 20 per cent. remained constant, and the carbon of steel must vary according to the purpose to which it was to be put, it will be seen that by choosing suitable ratios of manganese and carbon in the manganese alloy the desired result was obtained.

As an interesting departure from the normal Bessemer process, it should be recorded that the Swedes developed an indigenous modification based on the use of crude iron rich in manganese, and that at the end of the blowing period, sufficient of the element remained in the iron to make additions unnecessary. Some of us had the pleasure of seeing this process in operation last autumn through the courtesy of our Swedish friends, and it was interesting to see how the retention of manganese in the liquid bath permitted a technical control of the blowing operation, since the blowing could be arrested, the composition of the bath determined and blowing proceeded with intermittently until the desired carbon content was attained. considering the development of the early major steel processes, it should always be borne in mind that the physical chemistry of the reactions was even less completely mastered than at present, and that the whole of the development was necessarily accomplished by empirical methods. The achievements of the last century demand our appreciation.

Turning now to the discovery of manganese steel, Sir Robert Hadfield must have been a very young man when, in the early 'eighties of last century, the idea occurred to him of adding the manganese alloys then available in varying proportions to iron with the resultant production of a series of ironcarbon-manganese alloys, one of which proved to have astounding properties. It had previously been understood that if more than 2 or 3 per cent. of manganese was added to steel it became uselessly hard and brittle. Indeed, the whole of the experimental series produced by Sir Robert were very low in ductility in the as-cast condition, but his research was carried further, and by various experimental heat-treatments he discovered that in a range of composition, quenching in water from a high temperature produced alloys of great ductility, and other valuable characteristics. It will thus be seen that the discovery of manganese

steel did not simply result from the melting of the materials in different proportions, but necessitated, in addition, a well-conceived research covering subsequent treatment.

Manganese steel' is still produced to the original composition and treatment as determined as a result of the original researches It contains 13 to 14 per cent. of manganese, and between 1.0 and 1.5 per cent. of carbon. In the water-toughened condition it has a tensile strength of 60 to 70 tons per square inch, accompanied by a ductility indicated by an elongation of 40 to 60 per cent. Although very tough, its wear resistance is remarkable, and this property has led to its manufacture in very large quantities. Its great ductility, accompanied by its high strength, led to the production of many millions of soldiers' helmets during the War, whilst its non-magnetic properties have found applications in many, and in some extremely curious, directions. It should, however, be borne in mind that this steel is a ternary alloy, ie. it consists essentially of iron, manganese, and carbon, and, as Sir Robert points out in the second paper under consideration, his early discovery was facilitated by the high carbon content of the early manganese alloys, available at the time, resulting from their reduction in the blast furnace in the presence of an excess of carbon.

It always intrigued the minds of metallurgists as to what would be the properties of iron-manganese alloys of similar composition in the absence of carbon, but until comparatively recently it was only possible to approximate to the necessary experimental conditions, owing to the difficulty of obtaining 'carbonless' manganese. The efforts of many investigators have culminated in it now being possible to fulfil the conditions reasonably. Sir Robert Hadfield has been able to produce a series of iron-manganese alloys in which the manganese content varies from 1.68 to 83.5 per cent, with a carbon content not exceeding 0 20 per cent. until the manganese exceeds 390 per cent. Whilst not even yet quite fulfilling the desire to produce a series free from carbon, yet the carbon content is undoubtedly exceedingly low when it is borne in mind that sufficient of each alloy was produced to investigate the wide range of properties satisfactorily. It is instructive that Sir Robert was able to secure metallic manganese containing 99.52 per cent. of the element with only 0.11 per cent. of carbon. A survey of the results will show that comparison is now possible of the data to be obtained from a 13.0 per cent. manganese steel containing 0 09 per cent of carbon, with the standard product, which contains approximately fifteen times that amount, that is, 14 per cent. The experiments indicate the necessity of the high carbon content for the essential wear-resisting property; that the non-magnetic properties can be achieved with the low carbon, but by considerably increasing the manganese content; but that the high strength and great ductility are impracticable, except with a substantial carbon content. The paper contains much data of value to the specialist, and although space prevents the writer doing so, the author duly acknowledges the work of others in the same field with a thoroughness which is by no means invariably a noticeable feature in scientific papers.

Manganese has its applications in other branches of metallurgy, and its compounds have been applied

industrially down the centuries, but enough has been written concerning its value to the key iron and steel industries to emphasise the importance of ensuring that, whether we be at peace with the world or not, our supplies must not be interrupted.

W. H. H.

### Lister's Methods in Surgery.1

By Sir W. Watson Cheyne, Bart., K.C M G., C.B., F R S.

IT is curious how events and discoveries fit into their proper place in the history of the world, and how one discovery may often dovetail into another and increase the usefulness of both. I have in my mind the discovery of anæsthesia and

asepsis

Anæsthesia alone was naturally a very great gain to mankind both in saving pain and in reducing shock, but in some respects it was a disadvantage. Before its introduction, the hall-marks of a good surgeon were rapidity in operating and thorough anatomical knowledge. The range of operative work, however, was not very great. But the fact that pain could be abolished and shock considerably reduced by anæsthetics had the effect of encouraging surgeons to perform more prolonged and intricate operations. The consequence was that, as sepsis was as frequent and as dangerous as before, this meant an increase in the number of cases of sepsis and in the mortality in the surgical wards, and surgeons became more doubtful than ever of the advisability of extending the area of surgery.

As soon, however, as Lister had firmly established his aseptic methods, this difficulty passed away; rapid and enormous extensions of the limits of surgery were introduced by him and his followers, and anæsthesia took a permanent and most im-

portant place in forwarding this

The times were indeed ripe for the revolution made by Lister in the treatment of wounds. For ages, those who practised surgery were constantly confronted by the various septic diseases following wounds, whether made accidentally or by the surgeon. Occasionally, some one had a glimpse of the truth, but the wound treatment, whatever its nature was, had as its object the application of dressings and medicaments in order to make the flesh heal, as opposed to Lister's principle of leaving the wound itself alone while striving to remove all agencies which might hinder the wound from healing.

The cause of the septic troubles was for long looked on as connected with the admission of air to the wounds, and when oxygen was discovered, that gas was generally blamed for setting up changes in the blood and tissues. But towards the end of the eighteenth century, John Hunter pointed out that it could not be the gases in the air which caused harm, for in cases of emphysema and pneumothorax due to fracture of a rib and puncture of the lung, the tissues and the pleural cavity became distended with air; but neither sepsis nor suppuration supervened. Therefore Hunter was in favour

 $^{\rm 1}$  From an address delivered at the Lister Centenary Celebrations at Edinburgh on July 20

of abolishing the masses of dressings which were most in vogue in those days, and contented himself with applying a piece of dry lint over the line of incision and encouraging drying of the lymph and blood—that is to say, healing by scabbing. His example was followed by others, who tried to aid scabbing still further by blowing warm air over the wound at frequent intervals, or by the use of powders, dusting the line of incision with them.

About the same time Abernethy advocated with considerable success the use of valvular incisions in removing loose bodies from joints and in opening psoas abscesses

At the beginning of last century, subcutaneous surgery was introduced and Delpach elaborated it. Although its range of action was comparatively small, it still remains one of the important surgical methods of the day.

During last century a number of methods of treating wounds were introduced with a certain amount of improvement in results. Such methods were: open treatment, water dressing, immersion, water bath, irrigation, occlusion, etc. Just before Lister began his work, various substances, chiefly in solution, which belong to the class of antiseptics, eg. coal tar, carbolic acid, iodine, hypochlorites, perchloride of iron, etc., were being tried, especially in France. Of these, carbolic acid was lauded by Lemaire, but these antiseptics were only used in septic wounds, and Lemaire and others missed Lister's great generalisations which were the basis of his work

I may mention here Lister's 'slogans.'

1. Destroy the bacteria before they enter and establish themselves in the tissues.

2. Antiseptics are not used as applications to the tissues of the body laid open by the surgeon, but to the bacteria which are present everywhere, in the air and on the objects around.

3. Let as little as possible of the antiseptic enter the wound, but do not be unnecessarily afraid of it because, so long as the bacteria are kept out, any superficial damage done by the antiseptic will be rapidly repaired without any acute inflammation or suppuration.

4. The failure of the previous attempts with antiseptics was due to the fact that they were applied to wounds in which bacteria had already gained a footing and, as there is very little chance of eradicating the bacteria at that stage, irritating antiseptics like carbolic acid only make matters worse

One would have thought that these principles.

were clear and, when taken along with the published results, would have been very convincing. It always was a great puzzle to Lister's staff that surgeons did not rush to Lister's clinic to see his results and to learn his technique. True, there were always some foreigners, chiefly Germans and others of the Scandinavian races present in Edmburgh, but the number of British surgeons was very small indeed. Thus, when Lister migrated to London in 1877 (eleven years after his first publication), the number of London surgeons who were using his methods or were impressed by his teaching was extremely small and could probably be counted on the fingers of the hands.

It is not easy to account for this state of matters. Among other things it was very difficult to convince surgeons that tiny pieces of protoplasm about  $\frac{1}{20000}$  inch in diameter could be the cause of the septic diseases; the surgeons of that day were interested in keeping up their anatomy and in acquiring great rapidity in operating, and minute germs and processes of fermentation seemed very far removed from practical work; before Lister's time, carbolic acid and other chemicals had been applied to wounds without any benefit.

Lister's statement as to what he had achieved was so contrary to the experience of other surgeons that they felt that there must be a fallacy somewhere, and they were quite sure that the fault did not lie with them They noted that Lister was constantly changing his technique and dressings, and came to the conclusion that this was because his results were not good. They apparently did not listen to his statements, that he did so with the object of reducing or removing the irritation of the antiseptic and at the same time simplifying his technique They also pointed out that primary union of wounds was not a very uncommon occurrence before Lister's time, but they ignored his statement that it was the rule in his wards, they further pointed out the disagreeable effects of carbolic acid on the hands of the surgeon and its occasional poisonous effects

In spite, however, of these and other objections which need not be recalled, Lister went on with his work. When he retired there was little to find fault with as regards irritation of the wounds or skin by the antiseptics, and sepsis had become a matter of the rarest occurrence when his methods were adhered to rigidly.

### News and Views.

To the exhibition galleries of the British Museum (Natural History) have recently been added two exhibits of exceptional interest, both concerned with the elephant family but otherwise quite different. In the Palæontological Gallery has been erected the huge skeleton of the great fossil elephant which was brought to light by a party of Royal Engineers when digging practice trenches by the Medway opposite Chatham Dockyard about 1911. The importance of the bones that had been dug up was, however, not realised until 1913, when Mr. S. Turner sent some of the bones to the Natural History Museum for identification. Efforts were then made to secure the whole of the skeleton that remained, and Mr. L. E. Parsons, under the supervision of the late Dr. C. W. Andrews, spent several months at Upnor carefully excavating and packing the specimens for removal to the Museum. Further work was necessarily prevented by the War, and afterwards progress was gravely hindered by the death of Dr. Andrews. Fortunately, Mr. C. Forster Cooper, of Cambridge, a well-known authority on this group of fossils, lent his aid, and Dr. W. Rushton Parker generously defrayed the heavy cost of the ıronwork fitting. Finally, in spite of the difficult times, money was found for the base and the rail, and at last, after fourteen years, the public are enabled to see the remains of this huge creature, which stood over 12 feet high.

The other noteworthy new exhibit in the Natural History Museum is a habitat group of the South African elephant (*Elephas africanus capensis*), once widely distributed over South Africa but now nearly extinct. At the time of the destruction of the Addo Bush herd, the Union Government presented the Trustees with the skin and skull of an immature

female and of a young male from the Addo Bush, and of an immature male from Knysna Forest. These three specimens, which were mounted in the Rowland Ward studios, compose the group, and the scene has been laid in the Knysna Forest because of its greater picturesqueness. The Union Government enhanced the value of the gift by the addition of timber -yellowwood (Podocarpus elongata) and ironwood (Olea laurifolia)—and vegetation—tree-fern (Hemitelia capensis), fern (Aspidium capense), palm (Strelitzia augusta), and "Tangles" (Helichrysum)-all carefully collected and packed by the Forestry Department The Thesen and Union Castle Steamship Companies generously conveyed the material free of charge from Knysna Harbour to Cape Town and thence to London respectively. The exhibit has been designed and arranged by Capt. J. G. Dollman, and the lighting effects planned by Dr. G. F. Herbert Smith.

On Thursday of this week, July 28, Sir William Thiselton-Dyer reached the age of eighty-four years, and his many friends rejoice to offer affectionate tribute to one who has done so much to promote and extend the plant resources of the British Empire. Nearly two years ago (Sept 26, 1925) we published an appreciative article upon Sir William's work at the Royal Botanic Gardens, Kew, and its influence upon both pure and economic botany, and we are glad to know that its importance is widely recognised. He and Lady Thiselton-Dyer celebrated their golden wedding on June 23, and among the messages of congratulation were one from Mr. L. S. Amery, Secretary of State for the Colonies, and another from Prof. von Goebel, the doyen of German professors of botany. Mr. Amery referred appreciatively to Sir William's studies in the field of botanical enterprise,

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by which he has "rendered such valuable services in all corners of the Empire," and Prof von Goebel "It was you who first brought English and German botany into association which—serving as it does purely ideal aims-could not be destroyed by the War: and, further, we German botanists remember with gratitude the great services which you rendered with regard to Kew, with which in company with the two Hookers your name also will always be connected." It should be as encouraging to scientific workers generally as it is gratifying to Sir William Thiselton-Dyer to know that the seed of voluntary scientific service, such as was sown by him during many years, has borne rich fruits for the benefit of the human race, and that its value is understood in many lands

International relations in the chemical industries figured prominently in the report of the Council of the Association of British Chemical Manufacturers, adopted at its eleventh annual general meeting on The chairman, Mr C. A Hill, declared that undoubted advantages, from an international point of view, would accrue from the existence of a firm of the size and importance of Imperial Chemical Industries, Ltd: he referred also to the fact that the Association has joined the British National Committee of the International Chamber of Commerce, which has just held a conference in Stockholm, and to the conversations which have taken place between representatives of the Federation of British Industries and those of corresponding organisations in France, Germany, and Italy. These conferences, which are associated with the League of Nations Economic Conference at Geneva, afford an opportunity, which appears to have been effectively used, of securing to chemical industry in Great Britain a voice in the discussion of concrete matters of material concern, as well as of bringing it into closer touch with the trend of thought and outlook elsewhere. In speaking of domestic legislation, the chairman expressed relief that the proposed Factories (No. 2) Bill has been dropped; the much discussed 'petrol tax' which, however, is not proposed in the present budget, can scarcely exclude benzole, the taxation of which would have a disastrous effect on the dyestuffs section of chemical industry. References were also made to the effects of the Rating and Valuation Act 1925, the Merchandise Marks Act 1926, the Safeguarding of Industries Act, the Therapeutic Substances Act, and to Regulations concerning preservatives in food.

The production of a monograph on the chemical industry of the world from the British point of view within ten days of the appearance at Geneva of a corresponding German publication was described by the vice-president of the Association of British Chemical Manufacturers, Mr. Perry, as a brilliant piece of work. In the discussion which ensued, Mr T. Morson advocated the conferring of municipal franchise on corporations and companies, and spoke of the increasing cost of national social services, a subject which was further elaborated by the Right

Hon. J. W Wilson Sir John Brunner, who gave an account of his recent visit to Berlin, said that the main discussions converged on restrictions on imports and exports; on the whole, there is a tendency in Germany to ask that such restrictions should everywhere cease Tariffs were also examined from the point of view of classification and nomenclature; double taxation in Germany and England is another great hindrance to international trade Fairs and exhibitions, it is generally felt, are overdone, and the opinion has been expressed that they are largely becoming a question of blackmail among the traders of various countries. Mr. F. H Carr said that although the intention of the Therapeutic Substances Act is entirely benevolent, it may, if properly handled, do much to build up a branch of chemical industry which, whilst now in its infancy, has an immense future. Considerable satisfaction was expressed by Sir William Pearce in regard to the great improvement which has taken place in the position of the chemical industries since the end of the War.

THE University of Leyden has once more done honour to the Dutch physicians, biologists, and instrument-makers of the seventeenth and eighteenth centuries, by holding a special exhibition of their portraits and scientific instruments in the physical laboratory of the University on the occasion of the sixth Congress of the History of Medicine, held on July 18-23 in Leyden and Amsterdam Drs. C. A. Crommelin, W. P. Jorissen, C. J. Van der Klaauw, and W. H Van Seters have collaborated in producing a catalogue of the 139 objects exhibited in illustration of the work of 's Gravesande, the Munchenbroecks, Huygens, Leeuwenhoek, and Swammerdam. Two of the exhibits, two object glasses made by Constantijn Huygens, junior, and signed by him "C. Huygens, 10 May 1686, Ped. 122" and "C. Huygens, 19 Jun. 1686, Ped. 84," are of great interest, because they are accurately dated documents which, taken in conjunction with the three object glasses in the possession of the Royal Society of London, and dated June 4, June 26, and July 23, 1686, are evidence of the great industry and rapidity of working of the maker. We also note the reappearance of a quadrant made by J. M. Kleman for Boerhaave for use at his country house at Oud-Poelgeest. Although not stated in the catalogue, this quadrant, after being exhibited at Oxford in 1919, was given to the University of Leyden by the late Sir Wılliam Osler.

MM PIERRE and Gérard Deffontaines record in L'Anthropologie, t. 37, Nos. 1-2, the discovery of a Tardenoisian station at Cape Blanc-Nez, a little to the east of the road from Sangatte to Escalles. It is situated on a mound or small hill of tertiary sands overlying the chalk which in effect is a western terminal of the Flanders hills, and is sharply differentiated from the surrounding country by the distinctive character of its vegetation. It affords another example of the close association of the Tardenoisian microlithic culture with a sandy heath-like country. The authors suggest that while the microlithic industry

might be appropriate here to a mode of life which depended upon proximity to the sea, the association with sandy soil might be due to the facilities it afforded in a light soil for the beginnings of agriculture. This, while possible, would scarcely seem probable, and it is far more likely that both the association with this type of ground and the small implements of the industry are due to the character of a population which from necessity or choice had turned its hunting activities to small game as well as to fishing

It has been decided to erect a monument at Lyons to the late Count Hılaıre de Chardonnet, the 'Father' of the artificial silk industry Chardonnet was born at Besançon on May 1, 1839, and died at Rome on Mar. 12, 1924. Educated at Besançon, where he studied chemistry under Prof Loir, Pasteur's brotherin-law, he passed into the École Polytechnique at twenty years of age and afterwards devoted himself to scientific research. Many of his papers were read to the Paris Academy of Sciences His first patent in connexion with the production of artificial silk, taken out on May 12, 1884-"Sur une matière textile artificielle ressemblant à la soie "-was the result of his investigations between 1878 and 1884. 'Chardonnet' silk was exhibited at the Paris Exhibition in 1889, a factory was erected at Besançon soon after, and in 1891, 12 tons of the new material was produced. For 1926 the world's production of artificial silk was estimated at 120,000 tons.

THE central place in the proposed plan of a thorough survey of the natural resources of Armenia is given (as stated in the Information Bulletin of the Russian Academy of Sciences, No. 7-8, 1927) to the investigations in the basin of Lake Goktcha or Sevang. It is suggested that the waters of this enormous mountain lake might be utilised for irrigating vast tracts of lands which cannot at present be cultivated; but this is connected with the possible lowering of the level of the lake itself, and thorough hydrological studies of the lake will be undertaken with this view. It is taken into account also that the scheme may result in some changes in the climate of the surrounding country, so that thorough climatic studies will be also made. The soils and vegetation of the lands proposed for irrigation will be studied by several fieldparties in order to estimate definitely the agricultural value of the scheme. As the alteration in the regime of the lake cannot possibly be without its effects on its water fauna, a study of the latter, already in progress at the special hydrobiological station, will be continued on a larger scale and with the view of evolving a scientifically sound scheme of control of fisheries.

The paper on modern tramway equipment read by A. V. Mason to the recent congress at Bath of the Tramways and Light Railways Association is of interest as showing the difficulties in the way of tramway companies and how they propose to get over them. Owing to the speed of motor-cars it is considered that 25 miles per hour is a suitable normal speed for tramcars. A modern tramcar takes

150 yards from rest before its speed reaches this value, and then nearly another 150 yards to come to rest, if violent changes of speed are to be avoided. It takes from  $1\frac{1}{2}$  to 2 minutes to unload 90 passengers from a tramcar A motor omnibus is much more mobile. Everything to-day is being subordinated to speed. But speed needs power, and the starting current of modern tramcars is often more than 250 amperes, and this makes heavier supply mains necessary. On a day when skids are frequent the driver of a petrol vehicle goes slowly because he knows that the braking power is diminished. With a tramcar fitted with magnetic brakes, the driver runs at the same speed on all days as he knows by experience that the brake can always pull the car up quickly, and if the wheels skid they are released automatically. A recent improvement is to energise the magnetic brakes directly from the trolley wire. Unfortunately magnetic brakes tend to wear away the rails rapidly. When visiting Paris, Mr. Mason was impressed by the smooth running of the tramcars and the absence of all rattling noises. This is due to the brake being applied to a drum. In America the economic position is being straightened, wages have risen 120 per cent. on pre-War rates, and the fares have been increased 50 per cent. Successful experiments have been carried out on an all-aluminium car at Cleveland

Since the arrival in India of a farmer Vicerov the subject of animal husbandry has received a new stimulus, as is witnessed by the publication of a new periodical, The Journal of the Central Bureau for Animal Husbandry and Dairying in India, Part 1 of which has recently been issued. It opens with a foreword by Lord Irwin himself, breathing that active interest in livestock which his career in Great Britain leads us to expect "For the past two centuries," he says, "England's gentleman farmers have taken the lead in stock-breeding. . . . Let India's landed aristocracy follow their example"; and he rightly adds the reproof-"at present the tendency of the educated classes is to immerse themselves in politics or the law." The importance of the improvement of livestock in India cannot be exaggerated. A writer in the new journal estimates that the drain on the resources of the country caused by the enormous number of useless cattle maintained amounts to no less than 60 crores (upwards of 30 millions sterling annually). It is significant also to learn that although India is the country of the cow, the price of milk in Calcutta at the present time is 75 per cent. higher than the current retail price in London The improvement of the yielding capacity of the Indian cow is an obvious line of attack, and it is gratifying to learn that already considerable progress has been made in this direction. We wish this new venture the success which the importance of its subject fully deserves.

The most interesting of recent accessions to the Geological Department of the British Museum (Natural History) is a piece of rock from the immensely ancient Archæan rocks of Carelia, eastern Finland, presented

by the Director of the Finnish Geological Survey This rock displays a peculiar structure closely resembling some of the structures of approximately the same age in North America that have been described by the late C D Walcott as fossil Algæ. It has therefore been named Carelozoon jatulicum, and is by some experts regarded as evidence of life millions of years before the oldest known undoubted fossils. Among recent purchases are a few hundredweight of rough chunks of rock from Nevada; these are filled with ammonites of Middle Triassic age, as well as a few bones of an ichthyosaur. The specimens will be carefully extracted in the workshops of the department. Mr. F M Mackwood has presented to the Department of Entomology of the Museum sixty boxes of butterflies and moths, collected by himself ın Ceylon Included in the thirteen boxes of butterflies is a number of rarities, while the forty-seven boxes of moths form a welcome addition to the extensive collections of Ceylon moths already preserved in the Museum.

Among the objects figured in the recent Records of Additions to the Hull Museum, is an example of a bronze palstave. This form of bronze age axe, in which the cutting edge is at right angles to the septum between the flanges for hafting, as was noted by Sir John Evans, is of particular rarity in England. The Hull Museum specimen was recently found at Messingham in Lincolnshire. It is  $4\frac{1}{2}$  inches long, the cutting edge is slightly more than  $1\frac{1}{2}$  inches in length, and the implement weighs 5 oz. Unlike the two figured by Sir John Evans, which were fairly straight in the shaft, it has a well-shaped semi-lunar cutting edge resembling an Irish example also figured by Sir John Evans.

A COMMITTEE representative of agricultural interests in the northern counties of Great Britain, and under the chairmanship of the Duke of Northumberland, has issued an appeal for a fund for a memorial to the late Prof. Douglas A. Gilchrist, who died on April 4 shortly after his retirement from the chair of agriculture at Armstrong College, Newcastle-on-Tyne. The memorial will probably consist of a scholarship at Armstrong College for post-graduate students in agricultural science, or, should the fund be insufficient, for the award of a prize or prizes to agricultural students. Contributions may be sent to the honorary secretary, Mr. C. Williams, The Moothall, Newcastle-upon-Tyne.

APPLICATIONS are being invited by the Institution of Civil Engineers until Sept. 16 for the Yarrow and William Lindley scholarships. Applicants for the Yarrow scholarships must be British subjects who are not more than twenty-three years of age and who, desiring to become engineers, lack sufficient means to enable them to pursue their practical training or their scientific education. The scholarships are ordinarily of values from £50-£100 per annum for one, two, or three years. Applicants for the William Lindley scholarships must not be more than twenty-three years of age, and must be children of corporate members of the Institution

whose means are madequate to defray all the expenses incidental to an engineering training. The fund provides for (a) a major scholarship of £80 per annum for engineering study at the University of Cambridge, tenable for three years, and (b) a scholarship of £40 per annum for scientific education or practical training in engineering.

THE Library of the Chemical Society will be closed for stocktaking from Monday, Aug 1, until Saturday. Aug 13 inclusive, and will close each evening at 5 o'clock on Aug. 15—Sept. 10.

By arrangement with the London County Council, the Imperial Institute cimema will be open from 2 40 PM. to 5 30 P.M. on Sundays for the free display of films relating to the life and industries of the Dominions, India, the Colonies and Protectorates. The cinema is open free on week-days from 10.30 A.M. to 12.30 P.M. and from 2.30 P.M. to 4.30 P.M.

Mr. J. C. RICHARDSON, 74 Storemont Road, London, S W.11, writes to say that quicklime which has been soaked in petroleum, in contact with a little water evolves so much heat that the oil is readily ignited. This effect was probably used in the ancient incendiary mixtures, since the "Liber ignium" (twelfth century MS) describes the effect noticed by Mr. Richardson (R. calcem vivam . . . cum oleo . . aqua aspersa accendetur).

THE Astronomer Royal has arranged for the supply of enlarged photographic prints of the fine picture of solar prominences and inner corona secured at Giggleswick during the total eclipse of the sun on July 29. The moon's disc on the picture is  $7\frac{1}{2}$  inches in diameter, and the structure of the prominences and corona is remarkably fine and clear on the piint. Copies may be obtained, at the price of 2s. 6d. each. upon application to Mr F Jeffries, Royal Observatory. Greenwich, London, S.E 10.

ANOTHER of the important catalogues of second-hand science books (No. 409) of Messrs. Bernard Quartch, Ltd., 11 Grafton Street, W.1, has just been circulated. As usual it gives particulars of many choice and rare volumes. The contents are arranged under the sections of botany, agriculture, early medicine and surgery, forestry, fruit-culture, gardens and gardening, herbals, modern medicine, and tobacco.

Messrs Dulau and Co , Ltd., 32 Old Bond Street, W.1, have just issued a very interesting and important catalogue (No. 150) of works on science published prior to 1800. It gives particulars of upwards of 400 volumes dealing with botany, horticulture, agriculture and herbals, general natural history, medicine, astronomy, mathematics, sundials, etc. Many of the works listed are extremely rare. The catalogue, which can be had upon application, is worthy of perusal.

On every hand the development of scientific control brings in its train new methods of analysis and testing, and eventually convention crystallises into standardisation. Instrument makers must exert themselves to keep pace with the supply of the necessary equipment, and what this involves may be seen from the catalogue dealing with the "Analysis of Coal and its By-Products," just issued by Baird and Tatlock (London), Ltd. It has 136 quarto pages, is illustrated, and seems to include more than most of those interested in fuel analysis are likely to require. Thoughtfully, the proposed standardised methods of coal analysis are included in summarised form, and also a variety of useful information, presumably to encourage us to look inside as often as possible. A catalogue of "Apparatus for Testing Petroleum Products" stocked by the same firm occupies 44 pages and covers the requirements of the tests of the Institution of Petroleum Technologists.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned .- A temporary lecturer in agriculture under the Wilts County Council Agricultural Committee—The Organiser of Agricultural Education, Polebarn House, Trowbridge (Aug. 6). A junior assistant in the department of civil engineering of the Queen's University of Belfast-Prof. Hummel, The Queen's University, Belfast (Aug. 13). A director of the School of Egyptian Arts and Crafts, Cairo—The Under-Secretary of State, Ministry of Education, Cairo, Egypt (Aug. 15). An assistant lecturer in mathematics in the Bradford Technical College—The Principal, Bradford Technical College, Bradford (Aug. 23). An assistant woman lecturer and demonstrator in botany and an assistant woman demonstrator in physics at the Royal Holloway

College—The Principal, Royal Holloway College, Three posts at Englefield Green, Surrey (Aug 25) the Royal Veterinary College, namely, a principal, a director of the Research Institute in Animal Pathology, and a professor of pathology—The Secretary, Royal Vetermary College, Camden Town, S W.1 (Aug. 31). A professor of English language and literature in the University of Melbourne—The Agent-General for Victoria, Victoria House, Melbourne Place, W.C.2 (Oct. 1). Two research scholars at the John Innes Horticultural Institution—one, a botanist, to work at genetic and cytological problems, and one, a chemist. to work at problems of migration and storage with the plant—The Director, John Innes Horticultural Institution, Merton, S W.19. An assistant lecturer in physics in the University College of the South-West of England —The Registrar, University College of the South-West ot England, Exeter. Evening lecturers at the Croydon Polytechnic for electrical generation and transmission, advanced building construction and quantity surveying—The Principal, Croydon Polytechnic, Scarbrook-Road, Croydon. A science master at the Leods Grammar School - The Headmaster's Secretary, Grammar School, Leeds. A chief lecturer to take charge of the chemical department of the Woolwich Polytechnic-The Principal, Woolwich Polytechnic, S.E.18. A junior assistant under the directorate of Metallurgical Research, Research Department, Woolwich-The Chief Superintendent, Research Department, Woolwich, S.E.18.

### Our Astronomical Column.

RECENT MAGNETIC DISTURBANCE.—A considerable magnetic disturbance, lasting about 9 hours, was registered between July 21 and 22 at Greenwich and at Abinger, Surrey. The disturbance, which commenced suddenly at 21<sup>h</sup> on July 21, reached its greatest intensity between 2<sup>h</sup> and 5<sup>h</sup> on the following morning and died away rapidly soon after 6<sup>h</sup>. The excursion shown by the declination magnet amounted to fully one degree. The disturbance was also well shown by the vertical force magnetometer.

A superficial examination of the sun's disc showed no spots likely to be connected with this disturbance At 21h on July 21, there were three unimportant groups of spots at distances of 38° west, 7° east, and 48° east of the sun's central meridian. A large regular spot was a little way on the disc at a distance of 78° east of the central meridian. It is possible, however, that spectroscopic observations may come to hand as an indication of an usually active region on the sun not represented by a sunspot, and at the time placed somewhere in line with the earth.

The Planet Jupiter.—Mr. W. F. Denning writes: "This planet may now be well observed, as it rises at the end of July at 9h 37m p.m. G.M.T., and will shortly be in view throughout the night as it comes above the horizon four minutes earlier daily, and arrives at opposition on Sept. 22. Mr. F. Sargent, of the University of Durham Observatory, states, in a letter to me, that he obtained a good observation of the planet's markings on the night of July 18 with a 10½-inch reflecting telescope. He says the Red Spot is really true to its name in colour, for it is a bright, brick red. It is quite an obvious, easy feature. By comparison with an observation by the Rev. T. E. R. Phillips on July 21, 1926, he found that the rotation period, during the past 12 months, was 9h 55m 37s, whereas the previous 12 months gave

9h 55m 33s, or 4 seconds less. The direct inference is that the motion of the object has recently undergone a considerable slackening in its rate of motion. Following the Red Spot there is a distinct prolongation of the south-temperate belt which bends northwards towards the south margin of the south equatorial belt. Mr. Sargent observed several dark and white spots on the margin of the north equatorial belt and states that according to his estimates the length of the Red Spot is now only 20°, but one boundary of the marking appears to be indefinite. Forty or fifty years ago the length of the spot was about 32°."

A DISCUSSION OF STELLAR VARIABILITY.—Prof. C. D. Perrine contributes a discussion on this subject to Astr. Nach. No. 5505 His argument is that all types of stellar variation are due to a common cause which he takes to be pulsation of the type now generally assumed to explain Cepheid variables. It is rather curious that Prof Perrine for a long time upheld the binary character of the Cepheids; in abandoning this explanation for these variables, he also abandons it for stars where it seems to be well established. For example, the duplicity of Capella was confirmed by the interferometer, and the eclipse explanation of Algol's light changes was confirmed by the fact that the rotation of the principal star could be measured by the Doppler effect (the two limbs being successively under observation) The results fitted in harmoniously with the binary hypothesis.

Prof. Perrine reaches his conclusion by grouping all the known variables by period and light-range and showing that they lie along continuous curves, each type filling up gaps left by the others. Probably few will adopt his new conclusions in their entirety, but statistical discussions of this kind are always of value,

and afford material for further study.

### Research Items.

SKELETAL RECORDS OF MORTALITY.—An investigation in which the method is at least as interesting as the results, is recorded by Prof. T. Wingate Todd in the Scientific Monthly for June. Since 1912 the anatomical laboratory of Western Reserve University has preserved the skeletons of all subjects, of both white and negro stock, delivered to the medical school, together with a record of the age of each individual An intensive study of this material, now 1400 specimens, with the view of determining appearances related to age, has made it possible to fix more accurately than hitherto the age at which death took place in any individual case, by an examination of the skeleton It thus becomes possible, by applying this method to the study of skeletal remains for which a record of the age of death is not available, to determine with approximate accuracy the incidence of mortality. For the present investigation an examination has been made of the material already mentioned in the Medical School, West African skulls in the Royal College of Surgeons, the Tasmanian skulls in the same collection, bronze age skeletons from Furness, medieval remains from Scarborough, and skeletal material ranging in date from A.D. 800 to A.D. 1000 from Pecos in New Mexico. Data for Rome and the Roman colonies in Africa and Spain for comparative purposes are taken from Macdonell's study of expectation of life in Rome, which was based upon the epitaphs of the "Corpus Inscriptionum Latinarum" of the Berlin Academy. In each case interesting results emerge, but the general conclusion is perhaps most significant. The data relating to primitive and early races alike fail to show the peak of death in senility which Pearson found in the mortality curve for England. The peak of mortality occurs at a moderately early age. The peak of old-age death is therefore a comparatively modern achievement resulting from greater safety and improved conditions of living. It differs from the peak of mortality in early and primitive peoples by roughly thirty years.

ANTHROPOMETRY OF NORTH AMERICAN INDIANS.-A continuation of Dr. Aleš Hrdlička's catalogue of human crania in the United States National Museum has been published as vol. 69, art. 5 of the Proceedings of the Museum. This part is the second to be issued, the first having appeared in 1924 as art. 12 of vol. 63. It covers: Algonkin and related Iroquois (563 crania), Siouan (285 crania), the Caddoes (15 crania), the Salish and Sahaptin (15 crania), the Shoshonean (69 crama), and the Californians (403 crama). In addition the author's records of crama in other institutions have been added. Of the different strains, the Algonkin shows almost throughout a distinct physical character, coinciding almost exactly with the linguistic family; while the Iroquois, though of different linguistic stock, and including some heterogeneous elements, are radically of the same physical type—dolichocephalic to mesocephalic, with high vault, medium to large face, medium to low orbits, and medium to relatively narrow nose. Sioux type, one of the best differentiated on the continent, has a mesocephalic skull of moderate to good size, a remarkably low vault-met with only in Athapascans and north-west coast tribes, and distantly among the Mongols—large face and jaws, medium to high orbits, and is mesorhine. The Californian tribes show considerable uniformity, are practically identical with the Shoshonean, and exhibit no traces of extraneous (non-Indian) influence.

THE THAMES AND THE RHINE.—The belief that the Thames and other English rivers were once tributaries

of the Rhine and that the combined rivers flowed northward to the Arctic Ocean over a plain now occupied by the North Sea, has long been accepted. Jukes Browne put the Arctic outlet north of the Shetlands; Clement Reid put it nearer the Humber; and there have been other modifications in detail. Prof. J. W. Gregory re-examines the problem in an article in the Geographical Journal for July, bringing new evidence from the fauna of the rivers and the hydrography of the North Sea. His paper is full of detail and can only be followed with the help of its maps, but the conclusion at which Prof. Gregory arrives is that the Thames did not join the Rhine but turned south through the Dover gate and west along the course of the present English channel, joined by the Hampshire rivers and the Seine. The Rhine flowed through the Zuyder Zee and was separated from the Thames by a land barrier in the North Sea plain now recognisable as a rise on the sea floor, which Prof. Gregory terms the Haisboro-Terschelling The rivers of the Wash and Humber probably joined the Rhine, which flowed westward of the Dogger Bank into the sea and possibly continued to the Norwegian trench. In either case, it would not have been connected with the rivers of Scotland. It is suggested that the land extended northwards only to the 40-fathom and not the 100-fathom line

AUSTRALIAN AGRICULTURAL RESEARCH.—F McDougall and A. S. Fitzpatrick, in Vol. 10, No. 2, of the Scottish Journal of Agriculture, give an account of agricultural research in Australia. The problems of the country are extremely diverse on account of the wide range in the climatic conditions and the variety of industries which are therefore possible. Both agricultural and pastoral industries have increased enormously in the last few years, but as hitherto farming has been on an extensive rather than intensive scale, and as only a small proportion of workable land is actually under cultivation, the scope for future development is large. The chief industry is wool production, and attention to sheep breeding on scientific lines has resulted in a striking increase in the yield of wool; for example, the average weight of fleece per sheep in 1850 was less than 4 lb., whereas m 1925 it averaged 7 69 lb. Wheat growing is the second important industry. Improvements in plant breeding and better methods of dry farming have considerably extended the wheat belt, and the possible wheat-growing area is now estimated at double that at present bearing that crop. Fruit affords many specialised problems. Besides investigations on diseases and insect pests, the suitability of various soils for irrigation and the study of the effect of green manuring on soil fertility are two of the more important lines of work. The biological control of serious weeds, such as the prickly pear, by means of the introduction of certain insects, seems to be proving entirely successful. Dairying, another important industry, can be carried on throughout almost the entire country; similar problems can, therefore, be studied under widely varying climatic conditions. Deficiency in the mineral content of pastures is thought to have a possible correlation with a number of animal diseases, and owing to the importance of the meat export trade the question is being thoroughly investigated. Research is being conducted under two organisations working in close collaboration, namely, the Commonwealth Council for Scientific and Industrial Research, which deals with the scientific aspects of the industries, and the Development and Migration Commission, which is concerned with the economic conditions of the country.

THE LIMBS OF CRUSTACEA AND TRILOBITES.—In their recent paper on the feeding mechanism of a mysid (Trans. R Soc. Edin vol. 55, 1927) Prof H G Cannon and Miss S M Manton criticise Storch's views on the evolution of the feeding limbs of the Crustacea and Trilobites While Storch considers the primitive crustacean feeding limb to have been a phyllopodium similar to that of the Anostraca, and to have functioned essentially as a filtering mechanism, they suggest that the primitive limb was a biramous paddle such as occurs in the posterior trunk segments of Lepidocaris. From primitive articulates possessing biramous limbs the authors consider that the Branchiopoda and other Crustacea evolved from forms in which the limbs projected ventrally from the body in two parallel series, while Marella and the Trilobites arose from forms in which the limbs projected laterally. Among the Crustacea the endopodite became a foliaceous swimming organ in the Branchiopoda, while in the Malacostraca the exopodite developed as the swimming part of the limb, but it became whiplike. In Marella and the Trilobites the exopodite became the swimming branch of the limb. The authors agree with the usually accepted homologies of the two branches of the limbs of Trilobites, they do not accept the suggestion of Storch for the 'reversal' of the endopodite and exopodite

A Burrowing Cirripede.—Major R B. Seymour Sewell (*Records Indian Mus.*, **28**, pp. 269-330, 1926) has made a detailed study of *Lithotrya nicobarica*, a cirripede which burrows in coral or coral conglomerate usually in such a position that the head, or capitellum, hangs vertically downwards. The author obtained in the Nicobar Islands 65 examples of this species the largest series hitherto obtained, and was therefore able to study the range of variation. The specimens were found to fall into four groups, which he believes to represent age-groups each corresponding to a year's growth. It would appear that the average length of life of the members of this species is about three years, but that a certain number of individuals may survive for a fourth year. Major Sewell gives a detailed description of the external characters, including the appendages, and of the alimentary tract, the nervous system, and the reproductive apparatus. All the species of Lithotrya appear to be hermaphrodite and are probably protandrous; no complemental or parasitic males have been observed in this A consideration of the changes that occur in individuals of L. nicobarica as age and size increase suggests that several so-called species, which have hitherto been regarded as distinct, are merely different varieties or life-phases of a single widely distributed The author records a distinct tendency towards 'right-handedness' in the capitellum indicated by the fact that the scales or laminæ of both scutum and tergum are rubbed off to a greater degree on the right side than on the left. The greater development of the longitudinal peduncular muscles on the right side would seem to be associated with the 'right-handedness' since the more violent movement of this side of the body would cause a more rapid removal of the older laminæ.

Marine Shells from the South-east Coast of the United States.—In 1885 and 1886 the U.S. Fisheries Steamer Albatross made a series of dredgings off the south-east coast of the United States. The larger specimens of mollusca have been already dealt with, but the examples from the fine siftings were reserved and worked at from time to time, as opportunity served, by the late Dr. W. H. Dall, the Pyramidellidæ being determined by Dr. P. Bartsch. The descriptions of these are now published (Proc.

U.S. Nat. Mus., vol. 70, art. 18) and account for 337 species, of which 204 are apparently new. Unfortunately, none of these new forms is at present figured.

HEREDITARY OBESITY IN MICE —It is well known that in mice, yellow is epistatic to other coat colours and that homozygous yellow mice do not occur owing to the lethal effect of the yellow gene in the homozygous condition. Dr Danforth has recently shown (Jour of Heredity, vol 18, No. 4) that healthy yellow mice always become abnormally fat on an ordinary diet, this tendency being even more marked in the females than in the males. Thus yellow females are often twice, and sometimes thrice, as heavy as others. The fat is partly subcutaneous and partly attached to the viscera. The evidence indicates that the obesity is produced by the same gene which produces the yellow coat pigmentation and not by a separate factor, since no cross-overs appear On a restricted diet the yellow mice can gradually use up their store of fat, and it is suggested that the condition is similar to that in hibernating animals which store up fat in their tissues to be used later when no food is The condition is also compared with that in certain human families with a pronounced hereditary tendency to adiposity.

The Armenian Earthquake of Oct 22, 1926.—This destructive earthquake is described in a brief report by Prof S. Abdalian of the University of Erivan (La Nature, July 1). The epicentre was near Panyantour in the recently depressed valley of the Chirak. Several important faults traverse this valley, one of them running close to the volcano Alaghoz (about 15,000 feet in height). In the epicentral district the ground was much fissured, and in one fissure, passing through the village of Alexandrooka, a change of level of 15 mm. has occurred, the side next the valley being depressed with reference to the side of Alaghoz. At Dharh and Kazarabad, monuments in the cemeteries were rotated on their pedestals through an angle of 43°.

ICE ON THE COAST OF FINLAND.—The distribution of ice on the Finnish coast of the Gulf of Bothma, the Gulf of Finland, and Lake Ladoga, year by year, is recorded in a series of papers published by the Havsforskningsinstitutet of Helsingfors, entitled Oversikt av Isaona. They cover the winters 1914–15, 1915–16, 1917–18, 1919–1920, 1924–25. Reports for the other years have already been published. In a series of maps the nature and distribution of the ice is shown during the winter months. Freezing generally begins in November, and the ice has its widest extent in March, in April conditions improve, but the break up and disappearance of the ice is slow. Some of it may be present so late as June, but as a rule it has gone before the end of May. In some years January and February are little better than March. The data on which the distribution charts are based are collected by some seventy stations along the coast and in the Aland Islands. The reports also give the air and water temperature for representative stations during the winter months.

Hydrography of the Labrador Banks—The report for 1926 of the International Ice Observation and Ice Patrol in the North Atlantic (United States Coast Guard Bulletin, No. 15) gives an account of some oceanographical researches in addition to the itineraries of the patrol vessels and location of the icebergs. The observations for 1926 corroborate earlier ones to the effect that the density of water on the Grand Bank is usually higher along the zone of contact between

the Labrador Current and the Culf Stream than on either side of the Gulf Stream. But this high density does not exactly coincide with the abrupt transition from low to high temperature, but hes as a rule 25 miles to 35 miles inshore of it. Since the density wall unquestionably marks the easterly and the westerly sets of the Currents, it follows that the drop in temperature of the surface water does not mark the change in direction of the current. Another section gives a summary of neeberg records off Newfoundland between 1880 and 1926, with particular reference to the past twenty-six years, the records of which are plotted on a chart. It is shown that there are no ice-free months on the steamer tracks via Cape Race and only four on the tracks between the United States and Europe.

Molecular Spectra.—The band spectra of the vapours of sulphur, selenium, and tellurium, which were the subject of a recent paper by Prof. McLennan in the Philosophical Magazine, have been examined in more detail by B. Rosen in Berlin (Zeitschrift für Physik, 43, p 69) The resonance series and the fluorescence and absorption spectra are similar to those found in iodine by Prof. R. W. Wood, and are likewise ascribed to a simple diatomic molecule. Addition of inert gases to tellurium does not, however, increase the number of lines obtained in resonance, as it does with iodine, but merely reduces the intensity of those already present. The analysis of these spectra gives considerable information about the forces between the two nuclei and the heat of dissociation into atoms, as well as the conditions under which Stokes's rule, that the excited light is of greater wave-length than the incident light, breaks down

THE LIGHT FROM POSITIVE RAYS -Prof. W. Wien has recently succeeded in photographing the first five members of the fundamental Lyman series of hydrogen in the ultra-violet light from positive rays which had passed through a perforated cathode (Annalen der Physik, vol. 83, p. 1). His usual technique had to be considerably modified, the pencil of positive rays being shot excentrically into the barrel of a vacuum spectrograph, where its image was thrown directly by the grating on to a Schumann plate. The calibration of the plate for quantitative measurements of intensity was effected by intercepting part of the positive rays, and measuring the current carried by the remainder to a small metal disc, the corresponding spectra being examined afterwards by ordinary photometric methods. Prof. Wien's photographs show very clearly the decrease in the luminosity of the beam as it passes away from the cathode.  $H_a$  and  $H_b$  have the same decay constant, and the failure of the classical theory of radiation from accelerated electrons is again demonstrated by the incorrect relation which it predicts between the damping factors in this case, and in the allied Balmer series The grating used by Prof. Wien was ruled at the National Physical Laboratory, Teddington, on a blank supplied by Messrs. Adam Hilger.

Properties of Metals at High Temperatures.—Part of a research carried out at the National Physical Laboratory by Messrs. Tapsell and Clenshaw on this subject is published in a pamphlet issued by H M. Stationery Office, price 1s. 9d. Three metals are discussed: Armo iron and two steels with 0·17 and 0·24 per cent carbon respectively. All the more important mechanical properties have been measured up to about 600° or 700° C. Although there is no fundamentally new result, the values which have been determined for the creep and fatigue strengths at

these temperatures will be examined with care by those engineers to whom the strength of steel at high temperatures is becoming of minediate importance. So far as the limiting creep strength is concerned there is a progressive fall as the temperature is raised, for the mild steels from about 35 tons per sq. m. at 250° C to 5 tons at 500° C. The fatigue strength falls slightly as the temperature rises above the normal to a minimum at 150° C., from  $\pm 13$  to  $\pm 12$  tons per sq. m., then rises rapidly to  $\pm 17$  5 tons per sq. in. at about 450° C., and afterwards falls off to  $\pm 7$  tons per sq. m. at 600° C., the highest temperature used. There are many useful tables of test data and curves and a continuation of the work will be looked forward to with keen interest.

METALLURGICAL MICROSCOPES.—The latest edition of the catalogue of microscopes and accessories for metallurgical work issued by Messrs W. Watson and Sons, Ltd, contains in addition to the already wellknown forms of stands manufactured by them a new model "Service" microscope with one or two novel features. Most noteworthy of these is the stage. which may be swung out so that the stand may be used to examine large metallurgical samples too heavy to be placed on the stage For ordinary works' use this model would appear to be eminently suitable. A form of microscope designed in conjunction with Messis. Vickers, Ltd., for industrial use is illustrated and should appeal to those carrying out routine work of a high order. A projection cabinet designed by Mr. E A Atkins for demonstration and similar purposes is shown, and, where foremen and others are given some idea of microstructures, this would seem to be a piece of apparatus admirably suited to its purpose.

THE THOMAS GAS METER.—This meter, made by the Cambridge Instrument Co, Ltd., and designed primarily for the accurate measurement of industrial or towns' gas, in terms of standard cubic feet of moist gas measured at standard temperature (60° F) and standard pressure (30 inches of mercury) utilises the fact that the specific heat per unit volume of such gases is practically constant throughout the variations of pressure, temperature, density, and composition which occur in gas practice. The stream of gas flowing past an electric heater inserted in the gas main is heated exactly through 2° F., the difference of temperature being determined by two platinum thermometers inserted one on either side of the heater and forming two arms of a Wheatstone bridge. Under these conditions the energy input to the heater, measured on a wattmeter, is an accurate measure of the rate of flow of gas in the main. In order to maintain the bridge in balance with the two thermometers differing by 2° F., a third compensating thermometer, having a resistance equal to the difference of the first two, is inserted in the appropriate arm of the bridge. This temperature - difference thermometer also corrects automatically for variations of the water vapour content of the gas. Throughout, with varying flow, the bridge is maintained balanced and the energy input necessary to maintain the  $2^{\circ}$  F. difference of temperature varied automatically and recorded by an integrating wattmeter. If the gas flow ceases the meter is automatically put out of action. The meter is made in two standard formsthe return flow type, in which the meter is jacketted by the gas; and the vertical type, in which the meter is jacketted by a dead space containing gas. There are fourteen standard sizes, having maximum capacities ranging from 25,000 cubic feet per hour upwards. About 300 meters of this type are in use in various parts of the world.

## The Constitution and Synthesis of Thyroxine.

ABOUT a year ago we reserved to the work of Harington on the isolation of the active principle of the thyroid gland and the constitution and synthesis of its first degradation product, desiodo-thyroxine (NATURE, July 10, 1926, vol. 118, p. 65) A recent paper by Harington and Barger now completes this important piece of work by proving the constitution of thyroxine itself and describing a method for its synthesis (C. R. Harington and O. Barger, Biochem. Journ., 1927, vol. 21, p. 169). The formula for the compound, as suggested by the previous work and proved in the present research, shows that it is a tetra-iodo derivative of the p-hydroxyphenyl ether of tyrosine:

$$HO \left\langle \begin{array}{c} I \\ \\ I \end{array} \right\rangle O \left\langle \begin{array}{c} I \\ \\ I \end{array} \right\rangle CH_2 \cdot CH(NH_2) \cdot COOH.$$

Previous work had proved the constitution of desiodothyroxin and its synthesis had been accomplished: the problem remaining was the position of the four rodine atoms in the molecule and their insertion by synthesis. Three considerations made it appear probable that the rodine atoms occupied the positions given in the above formula: first, on fusing thyroxine with potash at a high temperature in the absence of oxygen, products were obtained exhibiting pyrogallol reactions, suggesting the presence of 3:4:5 trihydroxy benzene derivatives; secondly, nitrous acid and ammonia gave a colour reaction characteristic of benzene derivatives containing two iodine atoms in the ortho position to a hydroxyl or amino group; thirdly, on general grounds it appears probable that thyroxine is synthesised in Nature from tyrosine, through the coupling of two molecules of 3:5 duodotyrosine with the loss of one side-chain

Direct iodination of desiodothyroxine resulted in the uptake of two iodine atoms only, so that the introduction of the other two had to be effected before the phenylether synthesis was carried out. Several attempts were made to effect the synthesis, from compounds containing two iodine atoms or other easily replaceable groups in the required positions, of the body  $\mathrm{CH_3O.C_6H_2I_2.O.C_6H_2I_2.COOH}$  obtained by the methylation and subsequent oxidation of thyroxine, but without success.

Finally, however, a method was worked out, and the synthetic formation of this methylated oxidation product of thyroxine definitely proved the constitution of the latter. Quinol monomethyl ether was condensed with 3:4:5 triiodonitrobenzene, to give 3:5 diiodo - 4 - (4' methoxyphenoxy) nitrobenzene:

CH<sub>3</sub>O . C<sub>6</sub>H<sub>4</sub> . O . C<sub>8</sub>H<sub>2</sub>I<sub>2</sub> . NO<sub>2</sub> (the NO<sub>2</sub> group having a powerful mobilising effect on the halogen atom in the para position) This compound was then reduced to the anilme and the latter converted, by Sandmeyer's reaction, into the mirrle. The nitrile, boiled with hydriodic and acetic acids underwent simultaneous demethylation and hydrolysis, yielding the compound: HO . C<sub>6</sub>H<sub>4</sub> . O . C<sub>6</sub>H<sub>2</sub>I<sub>2</sub> . COOH; on addition of iodine in potassium iodide to a solution of the acid in concentrated ammonia, iodine was rapidly taken up, the uptake ceasing abruptly at two molecules. On methylation an acid, identical in every respect with that obtained by the methylation and oxidation of thyroxine, was produced. These experiments thus settled the orientation of the iodine atoms in thyroxine, since the last two, introduced in alkaline solution, must have entered the ortho positions to the free phenolic group

For the actual synthesis of thyroxine the starting-point was 3:5 diodo-4-(4' methoxyphenoxy) benzaldehyde; but it could not be condensed directly with a-aminopropionic acid, since the necessary reduction would displace the iodine atoms. Some success was attained by condensing it with hydantoin, but far better results were seen when hippuric acid was used. The resulting compound

$$\mathrm{CH_3O}$$
 .  $\mathrm{C_6H_4}$  .  $\mathrm{O}$  .  $\mathrm{C_6H_2I_2}$  .  $\mathrm{CH}$  :  $(\mathrm{C_3O_2N})$  .  $\mathrm{C_6II_5}$ 

was then converted into the  $\alpha$ -benzoylammo emmanic ester:

$$\mathrm{CH_{3}O} \cdot \mathrm{C}_{6}\mathrm{H}_{4} \cdot \mathrm{O} \cdot \mathrm{C}_{6}\mathrm{H}_{2}\mathrm{I}_{2} \cdot \mathrm{CH} : \mathrm{C(NH\cdot CO\cdot C}_{6}\mathrm{H}_{5}) \cup \mathrm{COCEt},$$

which, on boiling with hydriodic acid and red phosphorus, underwent demethylation and conversion of the side-chain into α-aminopropionic acid. The final stage of iodination in animonacal solution led to the uptake of two iodine atoms and the production of a compound identical in its chemical and physiological properties with natural thyroxine.

These two syntheses, then, establish finally the constitution of thyroxme. That the synthetic product has the same physiological properties as that isolated from the thyroid gland is shown in an appendix by D. M. Lyon: the basal metabolic rate of two cases of myxeedena was raised from about -40 per cent. to normal in the course of a week by three or four intravenous injections of 4-5 mgm. of the synthetic product on alternate days. These effects are quantitatively similar to those reported for natural thyroxine.

There can be no doubt, then, as to the identity of the artificial and natural thyroxines, and we can congratulate the authors on bringing their research to a successful conclusion.

### The Cockle Industry in Great Britain.

OUR knowledge of the edible shellfish of British coasts has been extended by Mr. F. S Wright in his "Report on the Cockle Beds and the Cockle Industry of England and Wales" (Fishery Investigations, Series 2, Vol. 9, No. 5, 1926. London: H.M. Stationery Office. 3s. net). Not only are his own investigations on the habits, bionomics, and growth of cockles of great value, but he has also done a great service by bringing together a mass of information on the subject which has hitherto been very scattered.

The economic value of the cockle is considerable, and its potential value even greater. Under the best conditions, when living in wet stable sand, cockles occur in vast numbers in comparatively small areas. Mr. Wright estimated that in one bed in the Llan-

rhidian Sands in South Wales, having an area of some 320 acres, there were present about four hundred and sixty-two million cockles of all sizes, the average number in each square metre being 357. A very interesting point brought out in the paper is that in some localities there are definite beds of young cockles which contain a dense population. As the cockles grow, many are forced to the surface, and those are then distributed over the general surface of the beds by the action of waves and currents. Though the enemies of the cockle include starfish, boring gastropods, gulls, and certain fish, the greatest danger to the beds comes from frost, storms, and currents, which may destroy great numbers of cockles in the winter months. The cockle gatherers themselves do

great damage with their rakes, and by leaving the young cockles which are too small for the market at the mercy of currents instead of scattering them over the beds where they can re-establish themselves By so doing they endanger their own livelihood as well as contravene the by-laws which regulate the cockle fisheries.

The chief centres of the cockle fishery in England and Wales are the Wash, the Thames Estuary, Carmarthen Bay, and Morecambe Bay. The cockles are gathered by raking, scraping, and digging, and are usually boiled, and the soft parts separated from the shells by sieving, before they are sent away to the market. The shells have a certain value, for they are often ground up to serve as grit for poultry.

Although it has not the high carbohydrate content of the native oyster, the food value of the cockle is considerable, and, in common with similar shellfish, it provides a valuable source of food the use of which might with great profit to the community be greatly extended. It is encouraging in this connexion to note that the annual quantity of cockles landed in Great Britain increased from 167,089 cwt. in 1923 to 300,721 cwt. m 1925, while probably many more were collected by casual gatherers. It is disconcerting, however, to learn that owing to the fact that English gatherers often refuse to take the trouble to pick out the larger cockles, which naturally command the best market, considerable quantities of cockles have been imported from Holland, where, apparently, the shellfish merchants pay more attention to the market C. M. Y.

# River Pollution and Fisheries.

DR. H. C. REDEKE has written a useful summary of the results of recent investigations upon the subject of river pollution for the International Council for the Exploration of the Sea (Rapports et Procès-Verbaux des Réunions, vol. 43, May. Copenhagen · Andr. Fred. Host et Fils. 1927). The direct influence upon fishes of sewage and of trade wastes containing organic matter or inorganic poisons, is discussed, and the methods used in treating the various pollutions on the Continent, in America, and in Great Britain are outlined. The report contains a comprehensive bibliography.

The disposal of noxious effluents is urgent in England, perhaps more so than on the Continent, where as a rule the towns have rivers carrying a greater quantity of water into which to discharge. As pointed out by Dr Redeke, the capacity of the rivers for self-purification allows the discharge of effluents up to a certain concentration without

material damage to the fisheries

Waste products containing organic matter, such as domestic sewage, the wastes from sugar beet, milk, or paper factories, abattoirs, etc., require treatment before reaching the rivers by allowing a natural fauna and flora of micro-organisms to act upon them for a sufficient length of time, usually under aerobic conditions, and the removal of solid matter, whereby their putrescibility is reduced. The problems of domestic sewage disposal have been solved on these lines in a very satisfactory manner on the whole; less attention has been paid to the analogous problems presented by trade wastes where, although similar methods are reported to give satisfactory effluents, the expense of installations or area of land required has militated against their general adoption

Trade wastes containing morganic poisons (gasworks, coke oven, artificial silk factory effluents) or inorganic poisons and organic matter (leather, paper, textile and glue trade effluents), each require particular treatment. Small volumes of highly polluting wastes can generally be got rid of by allowing them to seep through a sufficient amount of soil before entering any watercourse, but with large quantities the expense of treatment is the major problem.

In discussing to what extent pollutions will be injurious to fisheries, Dr. Redeke lays stress upon the extent to which an effluent will be diluted on entering a river, and concludes that the degree of purity of an effluent which should be aimed at depends upon such local circumstances; the discharge of substances directly poisonous to lower animals and plants should be prohibited, for these destroy the capacity of the stream for self-purification from organic wastes

### University and Educational Intelligence.

ABERYSTWYTH.—At a recent meeting of the Court of the University of Wales, it was announced that an anonymous donor has given a sum of £10,000 for the encouragement of research.

Cambridge —Mr J. A. Venn has been elected to a fellowship at Queens' College. H Barcroft, King's College, has been elected to the Michael Foster studentship in physiology.

Edinburgh —At the meeting of the University Court on July 18, a letter was received from Prof. J Cossar Ewart intimating his resignation from the chair of natural history. The Court accepted the intimation with very great regret, and expressed appreciation of the eminent services which Prof. Cossar Ewart has rendered to the University during his long and distinguished tenure of the chair, to which he was appointed in 1882.

On his retuement as physician to the Royal Infirmary Prof. G. Lovell Gulland intimated his resignation from the chair of medicine. The Court accepted the intimation with much regret, and resolved to record its grateful sense of the value to the University of Prof. Gulland's work as a teacher and physician.

The Court approved the terms of an ordinance founding the Buchanan chair of animal genetics, and directed that it be transmitted to the Privy Council and to the other Scottish universities. The foundation of this chair is part of the scheme for setting up a new and enlarged University Department of Re-search in Animal Breeding. The endowment consists of £20,000, half of which was contributed by Lord Woolavington, and half by the International Educa-tion Board of New York.

At a meeting of the Curators of Patronage of the

University on July 21, Prof. J. H. Ashworth, professor of zoology in the University, was unanimously appointed professor of natural history, as from Oct. 1, in succession to Prof. J. Cossar Ewart.

LONDON.—Dr. D. L. Mackinnon has been appointed as from Aug. 1 to the University chair of zoology tenable at King's College. Since 1919 Miss Mackinnon has been senior lecturer in zoology at King's College, and in 1921 the title of reader in zoology was conferred upon her. In addition to numerous papers in scientific journals, she has translated into English von Uexkull's "Theoretische Biologie" (Kegan Paul's International Library of Psychology, Philosophy, and Scientific Method, 1926), and has edited the translation from the Russian of Berg's "Nomogenesis" (Constable,

Prof. E. H. Kettle has been appointed as from October to the University chair of pathology tenable at St. Bartholomew's Hospital Medical College. Since

1924 Prof. Kettle has been professor of pathology and bacteriology in the Welsh National School of Medicine, Cardiff His published work includes the following. "The Pathology of Tumors" (Lewis and Co. 1st ed., 1916, 2nd ed., 1925) and numerous articles in the Journal of Pathology and Bacteriology, the Lancet,

and other medical journals.

Dr. Bronislaw Malinowski has been appointed as from August to the University chair of anthropology tenable at the London School of Economics. He has tenable at the London School of Economics. He has been University reader in social anthropology since 1923. He is the author of "Crime and Custom in Savage Society" (Kegan Paul, 1926); "Myth in Primitive Psychology" (Kegan Paul, 1926); "The Father in Primitive Psychology" (Kegan Paul, 1927); "Sex and Repression in Savage Society" (Kegan Paul, 1927); and of articles in "The Encyclopædia Britannica" (1926), "The Australia Encyclopædia" (1926), NATURE, Psyche, Zeitschrift für Volkernsuchalogie, and other journals Volkerpsychologie, and other journals
Dr W. H. Linnell has been appointed as from

Aug. 1 to the University readership in pharmaceutical chemistry tenable at the School of Pharmacy. From 1924 until 1926 Dr. Linnell was an organic research chemist at H.M. Fuel Research Station, and since October 1926 he has been lecturer in pharmaceutical chemistry and Director of the Chemical Research Laboratories in the School of Pharmacy.

OXFORD.—The following elections to University scholarships on the Theodore Williams foundation have been made: F. M. Trefusis, Exeter College, and M. W. C. Oldfield, University College, in human anatomy; Joyce Wright, Somerville College and J. G. anatomy; Joyce wright, somerville College and J. G. Reid, University College, in pathology, A. L. Jacops, Jesus College, and A. W. D. Leishman, University College, in physiology. Mr. Robert Pakenham-Walsh, of University College, has been awarded the Welsh prize for excellence in anatomical drawing.

Dr. Harlow Shapley of Harvard College Observatory, Cambridge, Mass., has been appointed to deliver the Halley Lecture in 1928.

Two useful educational bibliographies have reached us from the United States Bureau of Education: a classified list of publications of the Bureau of special interest to secondary school teachers, and a record (Bulletin, No. 2, 1927) of current educational publications. The latter is a fifty-eight-page pamphlet comprising some six hundred titles classified and annotated.

THE New Education Fellowship is holding its fourth international conference at Locarno on Aug. 3–15, the general theme being "The True Meaning of Freedom in Education." In the list of speakers appear the names of the following, among others: Prof. Pierre Bovet, Director of the International Bureau of Education, Geneva; Mrs. Beatrice Ensor and Dr. Elisabeth Rotten, Directors of the New Education Fellowship; Dr. Alfred Adler, founder of the School of Individual Psychology, Vienna; Prof. Carson Ryan, of Swarthmore College, U.S.A., President of the National Vocational Guidance Association; Dr. Carleton Washburne, Superintendent of Schools, Winnetka, U.S.A.; Sir Jagadis C. Bose; Prof. O. Decroly of Brussels, originator of the Decroly method; Dr. Adolphe Ferrière, founder of the International Bureau of New Schools; M. P. Otlet; and Mme. Guérntte, of La Nouvelle Education. Bedales, Frensham Heights, and other pioneer schools are to be represented. There will be an exhibition of children's work and auto-didactic material. The headquarters of the Fellowship are at 11 Tavistock Square, London, W.C.1.

## Calendar of Discovery and Invention.

July 31, 1846.—In 1840, Lord Armstrong, then a lawyer thirty years of age, in a letter to the Mechanics' Magazine, directed attention to the advantage of water under pressure as a mechanical agent and a Six years later he erected a reservoir of power crane on the quay at Newcastle which was worked by water power, and on July 31, 1846, took out a patent for an "apparatus for litting, lowering and hauling." This was the beginning of the present extended use of hydraulic pressure for cranes, capstans, lifts, gun machinery, and machine tools To develop his machinery, Armstrong in 1847 joined the small engmeering firm of Donkin, Cruddas, Potter, and Lambert, of Elswick, and from this sprang the worldfamous engineering works on the Tyne.

August 1, 1774—Oxygen was discovered independently by Priestley and by Scheele, Priestley's famous experiment with the red oxide of mercury being made on Aug 1, 1774. The new gas, thought by Priestley to be common air deprived of its 'phlogiston,' was called by him 'dephlogisticated air,' and it was Lavoisier who named it oxygen.

August 3, 1677.—One of the earliest scientific academies was that founded in Germany in 1652 and on Aug. 3, 1677, given the title "Sacri Romani Imperii Academia Naturae Curiosorum" by the Emperor Leopold I. The inauguration of this society was stimulated by the writings of Bacon, and it is known to-day as the "Leopoldinish-Carlonische Deutsche Akademie der Naturforscher" of Halle.

August 4, 1877.—Many inventors have contributed to the improvement of internal combustion engines, but the greatest single improvement was that made just fifty years ago by the German engineer, Nicolus Otto (1832–1891), who on Aug. 4, 1877, took out the German patent for the well-known four-stroke cycle of operations. Lenour and Hugon had produced the first practical gas engines, and these had been superseded by the engine invented by Otto and Langen in 1866. All these, however, were far inferior to the new type of Otto, who introduced the plan of compressing the explosive mixture in the working cylinder as proposed by Barnett in 1838.

August 4, 1894.—The exploration of the upper atmosphere by means of self-registering instruments lifted by kites was initiated by Abbott Lawrence Rotch (1861-1912), whose first experiments were made on Aug. 4, 1894. Rotch was the founder of the meteorological observatory at Blue Hill, Hyde Park, Mass., 635 feet above sea-level

August 5, 1816.—Among the pioneers of the electric telegraph was Sir Francis Ronalds who, before the invention of the voltaic battery and the discoveries of Oersted, in 1816 laid down some miles of wire in his garden at 26 Upper Mall, Hammersmith, and transmitted charges by means of friction machines. His offer of a demonstration led to the Admiralty official reply, dated August 5, 1816, "That telegraphs of any kind are now totally unnecessary, and that no other than the one in use [the semaphore] will be adopted.'

August 6, 1812.—Regular steamboat traffic in Europe began with Henry Bell's Comet, launched on July 24, 1812, which began her trips on Aug. 6. Glasgow Herald of Aug 10 contained the following paragraph: "We understand that a beautiful and commodious boat has been just finished, constructed to go by wind, power and steam, for carrying passengers on the Clyde between Glasgow, Port Glasgow, Greenock, and Gourock. On Thursday it arrived at the Broomielaw in three hours and a half from Port Glasgow.'

### Societies and Academies.

#### LONDON

Optical Society, June 9.—T H. Harrison The use of photo-electric cells for the photometry of electric lamps. A description is given of apparatus and experiments designed for giving the highest accuracy and precision in the photometry, using photo-electric cells, of electric lamps Although the methods adopted are not novel, yet every care has been taken to obtain the highest sensitivity in the photo-electric current measuring apparatus and to maintain the lamps at a steady, accurately known voltage. It is claimed, therefore, that the results are useful in showing the maximum capabilities of photo-electric cells when used in the usual manner with a sensitive electrometer or electroscope Sources of error and their elimination and the computation of the accuracy of the results are discussed -R Kingslake perimental study of the best minimum wave-length A special telescope is defor visual achromatism scribed, in which the chromatic aberration can be varied continuously without introducing any other undesirable aberrations. By the aid of this apparatus, many determinations have been made as to the best type of achromatism for visual observations, in daylight, in artificial light, and on astronomical objects Several observers were employed to make settings, and their opinions as to the most desirable type of achromatism are tabulated and compared In general it is found that a moderate amount of undercorrection is required to give a truly colour-free image, that less undercorrection is needed if the best definition is to be obtained, and that a slight overcorrection is desirable for astronomical work—S. K Datta: On Brewster's bands (Part ii.). The nature of the patterns obtained by the superposition of two systems of Haidinger's rings when the actual law of spacing of the rings is considered is discussed.

Mineralogical Society, June 14.—A. F Hallimond: On the atomic volume relations in certain isomorphous series. For isomorphous salts of the eutropic elements potassium, rubidium. cæsium, the differences cæsiumpotassium and rubidium-potassium stand in constant ratio, and the same ratio holds good for the free metals, though these are considerably larger than in the combined state, the constancy does not extend to the salts of ammonium or thallium. A modified additive relation is indicated, the volumes of the metals when free and when combined being in the same ratio as the differences for the free metals and for the respective isomorphous series. This would appear to be a distinctive character of each 'eutropic' group of elements.—P. K. Ghosh · Petrology of the Bodmin Moor grante (eastern part), Cornwall. Three types of granite are mapped and described in detail . (1) an earlier coarse-grained 'normal granite,' followed by (2) a coarse-grained granite of Godaver type, and (3) a fine-grained granite. Various minor intrusions connected with these are described, and also their altered faces. Several types of hornfelsed inclusions of sedimentary rocks are distinguished —P. G. H. Boswell: On the distribution of purple zircon in British sedimentary rocks. The properties and behaviour under radioactive treatment of purple zircon from sedimentary rocks are described The mineral occurs at practically every horizon in British sedimentary rocks. In the Carboniferous, Permian, Triassic, and Aptian rocks it is especially abundant, and is there associated with numerous other minerals apparently freshly derived from crystalline metamorphic rocks. —J. Drugman: On  $\beta$ -quartz twins from Cornwall.

3-quartz seems to be sufficiently differentiated from a- or low-temperature quartz for the two to be treated quite apart from each other. This is specially the case with the twin-laws one observes in these 3-quartz, twinning with inclined axes is a very comabundant in the Cornish localities at Belowda Beacon, a china-clay pit near Belowda Beacon and Wheal Coates. Besides twinning on (1011), Estérel twinning, and twinning on (1122), three new laws are stated, namely, twinning on (3032), confirmed by a good Estérel specimen; twinning on (2021) (and perhaps on the Zinnwald law) and lastly twinning on (2132), This latter also confirmed by an Estérel specimen is, however, probably of extremely rate occurrence

—E. V. Holt and H. F. Harwood: The separation of
manganese in rock analysis. The whole of the manganese can be completely precipitated with the alumina and ferric oxide. The solution after removal of silica is diluted to 400 cc, heated to boiling after the addition of ammonium chloride, and ammonia added to alkalinity. Bromine water is then run in very slowly from a tap funnel, small additional quantities of ammona being simultaneously added to keep the solution alkaline When the addiadded to keep the solution alkaline tion of the bromine is complete the liquid is boiled for one minute and then filtered. The precipitate is redissolved and the precipitation repeated; in the combined filtrates lime and magnesia are determined by the usual methods The results are perfectly satisfactory up to a limit of 50 mgm MnO; when more than that quantity is present, some lime and magnesia are liable to be carried down with the alumina precipitate, but such a case will practically never occur in rock analysis.—L J. Spencer: Corundum twins from Transvaal. Large twinned crystals of corundum, up to 6 inches across but only about an eighth of an inch thick, are abundant in plumasite rock near Bandoher Kop, northern Transvaal twin-plane is a face of the primary rhombohedron and the twinned crystals have a form resembling arrow-heads.

Royal Meteorological Society, June 15.—J. Edmund Clark, I D. Margary, and R. Marshall: Report on the phenological observations in the British Isles, December 1925 to November 1926. 373 sets of records were received, but observers would be welcomed in the western halves of Ireland and Scotland, and all Scotland north of Inverness. The five weeks' cold spell preceding Christmas 1925 retarded the first indications of the new season's growth, but this was quickly neutralised by warmth equally abnormal, culminating in the closing week of winter and continued on to Easter. In consequence flower, bird, and insect records were very early up to mid-April, notable being those of the arrival of cuckoo and swallow and flowering of hawthorn. Then everything was retarded by a long spell of cold, worst about mid-May, injuring the fruit crop, particularly apples. June was cool and very dry and in many parts July brought a deluge. Field crops were helped by a dry summer and fairly warm August, warm September and early October. Grain expectations failed of full realisation upon threshing. Destructive mid-October frosts damaged late potatoes and practically wiped out autumn colouring. Many records were obtained of the return after this of swallows and housemartins, often lingering all through November and in some cases into December.—G. C. Simpson: Past climates The paper discusses from the meteorological point of view the possible changes in climate which can be brought about by changes in the physical condition of the earth's surface—chiefly changes in the extent and distribution of the land masses and changes in their height-unaccompanied by any variation in solar The zonal distribution of temperature has not materially changed; there must always have been a cold polar zone, a warm tropical zone, and an intermediate temperate zone, all very similar to those which exist to-day. Further, a detailed examination of the existing variations in mean annual temperature along various circles of latitude leads to the conclusion that no rearrangement of land and water could have produced larger variations of mean annual temperature than are to be found in the northern hemisphere to-day. The ice sheet which covered northwest Europe during the last great ice-age could not have been caused by the elevation of Scandinavia The present conditions in tropical regions, where in the coldest parts the snow-line is to-day more than 5000 metres above sea-level, lead to the conclusion that ice could never reach sea-level within the tropics.

#### Dublin

Royal Irish Academy, June 27 -H. Ryan and V Coyle: The hydrolysis of n-butyl nitrate. n-Butyl nitrate, formed by the action of nitric and sulphuric acids on n-butyl alcohol, reacted very slowly with cold aqueous or alcoholic potash With a warm solution of potash the ester was, unlike those of the polyhydric alcohols, readily converted into butyl alcohol and potassium nitrate. In addition to these bodies, potassium nitrite and a resin were formed. Alcoholic ammonia had little action on the nitrate, but in the presence of sulphuretted hydrogen, butyl alcohol was formed very readily.—H. Ryan, J. Keane, and J. C. McGahon. On 3-nitrodiphenylene oxide. Two mononitro derivatives of diphenylene oxide are known. One of these melts at 182° C. and the other at 110° C, and each in turn has been assumed to be 3-nitrodiphenylene oxide. It is now shown that the latter body is a new mononitro-diphenylene oxide melting at 141°C, which is obtained by diazotisation of 2-amino-4-nitrodiphenyl ether, followed by elimination of nitrogen with formation of the diphenylene oxide grouping —Joseph Doyle and Phyllis Clinch. Seasonal changes in conifer leaves, with special reference to enzymes and starch formation. The absence of starch from evergreen leaves in winter is largely due to an internal change which necessitates, irrespective of temperature, a great increase in sugar concentration before starch synthesis begins. This has to be related to corresponding changes in the carbohydrate enzymes. Although invertase is always present. maltase, dextrinase, and amylase may be absent or much less active in winter. Starch may develop in the absence of maltase and dextrinase; and, in some cases, independently of assimilation, light may be necessary for its formation in winter. Osmic acid staining substances are very plentiful, but they are not fat, which is sparingly present if at all. Lipase is not detectable at any season.

### PARIS.

Academy of Sciences, June 20.—G. André and E. Demoussy The distribution of potassium and sodium in plants. From the experimental facts given, it follows that the distribution of potassium and sodium, considering only the soluble forms, is dependent on diffusion. During the growth of the plant the most mobile element, the potassium, travels farthest from the mixed solution. After the period of growth the ratio potassium/sodium tends to fall.—P. Viala and P. Marsais: A new disease of grapes (seleriasis), due to Sordaria uvicola. Details of mode of growth and effects of this fungus are given, which at present is confined to Bessarabia.—Pierre Bazy:

Remarks on the note by M. Raymond Hamet. protest against the conclusion that in cases of syncone under chloroform or other anæsthetics the injection of adrenalme may be harmful. The author contends that the value of the adrenaline injection in tends that the value of the adrenalme injection in such cases is well proved — Riquier — The general integration of the partial differential equation s=f(x, y, z, p, q) — Charles Camichel — The vortices provoked by an obstacle immersed in a flowing liquid. A résumé of experiments made by the author in collaboration with Dupm, Escande, and Teissié Solier — Amé Pictet and H. Vogel: The synthesis of maltose — René Maire and Paul de Peyerimhoff The discovery of Pinus nigra in the north of Africa This pine has not hitherto been met with in Africa. The age and position of the trees exclude the possibility of introduction from Europe during French occupation -Charles Fabry was elected a member of the section of general physics in succession to the late Daniel Berthelot, and Alexis Carrel a corres-Pondant for the section of medicine and surgery.

Otakar Borůvka The projective geometry of the analytical correspondences between two planes. Gaston Julia · Remarks on the singular right lines of congruences.—J. Hjelmslev The invariants of integral series—André Roussel: An intermediate method of the calculus of variations.—(1. Pólya: Integral functions with lacunar series -Gr. Fichtenholz. Suites of analytical functions — Biernacki: The displacement of the zeros of integral functions by their derivation.—Kiveliovitch. The periodic orbits of the problem of three bodies with impacts of two bodies.—P. Fatou · The movement of the nodes of certain orbits.—Emile Belot: The origin and values of the eccentricities of the orbits according to the dualist cosmogony -L. Rosenfeld: The magnetic electron and wave mechanics -V Posejpal: The yield of fluorescence of the K level for the Ka lines. -R. Descamps. The natural rotatory dispersion, in the range of the ultra-violet spectrum, of four aqueous solutions of tartaric acid Beauvais and Mesny: An arrangement of the Faraday cage for radio-telegraphy.—Mlle St. Maracineanu: Researches on the radioactivity of matter after long exposure to solar radiation. In a previous communication it has been shown that a leaden roof, which had been exposed for a long period to solar radiation, showed distinct radioactivity. That this lead was not originally radioactive has now been proved by cutting out a piece of the lead (2 mm thick) and examining t in the laboratory. Only the exposed face was found to be active, the radioactivity on the under side being nil. The possibility that the radioactivity found was due to radioactive deposits from the atmosphere was disproved. Zinc and copper from the same roof also showed radioactivity, but less than the lead .- H Deslandres . Remarks on the preceding communication. The importance of these results is emphasised and the necessity for additional research indicated. The facts at present known would appear to be best explained as being due to a special action of the sunlight .- H. Jedrzejowski . The charge of the a-rays emitted per second by 1 gram of radium. The method used was based on that of Rutherford and Geiger; with some additional refinements. The charge emitted by 1 gm. of radium was found to be 33.4 electrostatic units per second, corresponding to the number of a-particles  $N=3\cdot 50\times 10^{10}$  This is if good agreement with recent results of H. Geiger and A. Werner, of J. Thibaud and of L. Moitner, but is appreciably lower than the  $3.72 \times 10^{10}$  found by V. F. Hess and R. W. Lawson —A. Andant and E. Rousseau: The photolysis of hydrocyanic acid by the total radiations and by the filtered radiations of

the mercury arc The data given show that photolysis by ultra-violet light is hindered by the presence of radiations of longer wave-length—Eugene Cornec and Joseph Dickely · Studies on sodium perchlorate—Victor Tombard: The permeability of iron and of platinum to hydrogen The permeability of iron to hydrogen at a given temperature is proportional to the square root of the pressure. At constant pressure and varying temperature, the permeability of iron and and varying temperature, the permeaninty of iron and platinum to hydrogen, like that of nickel, is of the form  $d = a^t$  (a, constant; t, temperature).—Amand Valeur and Paul Gailliot: The passage from trimethylarsine to cacodylic acid. Trimethylarsine is converted into the dichloride by the direct action of chlorine; at 180° C. this gives methyl chloride and cacodylic ablanda and the letter is quantitatively. cacodyl chloride, and the latter is quantitatively oxidised to cacodylic acid by means of hydrogen peroxide.—Charles Prévost: An unexpected reaction of the di-isocrotyl dibromides -Marcel Bouis . The addition of hydrobromic acid to the allene hydrocarbons.—Paul Gaubert. Helicoidal building up in crystals.—Louis Barrabé. The Jurassic and Cretaceous sedimentary series of the western coast of Madagascar, between Manambolo and Manambao.— F. Blondel. The recent volcame action in the southeast of Indo-China The magnitude of the volcanic area is remarkable, but owing to the deep changes in the basalts and the absence of sedimentary strata, the exact date of the eruptions cannot be determined with accuracy.-J. MacLaughlin · Measurements on the large ions at Paris.—Ch. Maurain: Magnetic measurements in Alsace and Lorraine —Henri Coupin: The carbon nutrition of Penicillium glaucum by means of various organic compounds of the fatty series Out of 47 organic substances added to an morganic culture medium, Penicillium can use carbon from 22 of them, including ethyl alcohol, glycerol (but not glycol), sugars, malic and succinic acids -Denis Bach: The nitrogen nutrition of the Mucorineæ. The assimilation of the nitric ion.—Robert Lami: The influence of a peptone on the germination of some Vanda.—Jean Bathellier. The fungus cultures made by the Indo-Chinese ants—Ch. Brioux and J. Pien: The lime requirements of acid soils. The slow reappearance of acidity after saturation with lime.—Jacques Pellegrin: The barbel of with lime.—Jacques Pellegrin: Morocco.-H. Joyet-Lavergne: The relations between glutathrone and the chondriome. Some results obtained by the use of sodium nitroprusside as a histological reagent for glutathione.—Philippe Fabre: The shunt shock on the gastrocnemius of the frog.-Joseph Thomas: Injections of cancerous autolysates m the treatment of cancer.—Marcel Duval and P. Portier: The total carbon choxide content of the blood of freshwater invertebrates and marine invertebrates. The blood of freshwater invertebrates is richer in carbon dioxide than that of marine mvertebrates. No reason can be assigned for this difference.—R. Fosse and A. Hieulle: The identification of allantoic acid in the leaves of *Acer pseudo*platanus.-H. Cardot, J. Régnier, D Santenoise and P. Varé: The variations of the cortical excitability, in relation with the pneumogastric excitability, the thyroid apparatus and the muscular activity.—H. Simonnet and G. Tanret: The hypoglycæmic properties of galegine sulphate.—J. Cantacuzène and O. Bonciu: The agglutinability acquired on contact of scarlatma filtrates by bacteria heated to 60° C .--X. Chahovitch and Mile. Vichnitch: The energy metabolism in the course of experimental tuberculosis.

### ROME.

Royal National Academy of the Lincei, April 24.— L. Tonelli: A property of integrable functions.—

G. Armellini . Selective absorption of the terrestrial atmosphere and the effective and apparent stellar temperature The effect produced on the spectrum of a star by the selective absorption of the earth's atmosphere is to render the distribution of energy in the stellar spectrum such as would be obtained from the radiation of a black body at a temperature different from, and lower than, the effective temperature of the star. The difference between the two temperatures is proportional to the selective atmospheric constant and to the square of the effective temperature.—A. Lo Surdo The electric current filtered through a saturated thermionic valve If a saturated thermionic valve is inserted in a circuit with the object of filtering the current due to a pulsating electromotive force, the pulsations of the current are greatly attenuated but cannot be entirely eliminated—L. Rolla and G. Piccardi. Electro-affinity potential of molybdic anhydride Measurements made by the molybdic anhydride flame method give the value 2.73 volts for the electronic affinity potential of molybdic anhydride rendered free from bases by sublimation. This result is calculated on the assumption that, at the flame temperature employed, namely, about 1970° absolute, the anhydride undergoes no appreciable dissociation. —S Franchi Geology of the northern Appennines.—R. Calapso: A transformation of the rectilinear congruences W.—S Cherubino: The surface integrals of quadratic differential forms—S Bernstein: New demonstration of an inequality relating to trigonometrical polynomials —O Onicescu: Geodetic displacement, stability, and Whittaker's problem.—A. Rosenblatt: Kutta-Joukowski's theorem.—E. Fermi and F. Rasetti. Measurement of the ratio h/k by means of the anomalous dispersion of thallium —U. Sborgi: Anodic behaviour of metals in non-aqueous solutions. Comparison of the results obtained on electrolysing sodium and ammonium chlorides, and ammonium nitrate in aqueous and in ethyl alcoholic solutions indicates that, to a large extent, the anodic behaviour of metals is similar in aqueous and nonaqueous solutions.—G. Malquori: The systems  $AlCl_3$ —HCl— $H_2O$ , KCl—HCl— $H_2O$ , and  $KNO_3$ — $HNO_3$ — $H_2O$  at  $25^\circ$  (in.). The solubilities of alumnum and potassium chlorides in water are diminished by the presence of hydrochloric acid. On the other hand, potassium nitrate is increased in solubility by addition of nitric acid to the aqueous solution; aluminium nitrate, however, follows the general rule.-C. Fontana: Identity of the crystalline structures of Fe $_3$ S $_4$  and FeS. The results of X-ray analysis show that the interaction of magnetite and hydrogen sulphide under the ordinary pressure at 1000° is expressed by the equation:

 $\text{Fe}_2\text{O}_3$ .  $\text{FeO} + 4\text{H}_2\text{S} \longrightarrow 3\text{FeS} + \text{S} + 4\text{H}_2\text{O}$ .

The sulphur does not occupy a fixed, characteristic position in the crystal lattice, and the existence in the product of the reaction of the compound Fe<sub>3</sub>S<sub>4</sub> as a chemical individual cannot be regarded as proved-A. Ferrari: Crystalline structure of iodine. Investigation by Laue's method, in conjunction with the rotating crystal method, shows that iodine exhibits a rhombic lattice, the elementary cell of which consists of an orthogonal parallelepiped containing eight atoms and having the dimensions a = 4.760 Å U.; b = 7.164 Å.U.; and c = 9.783 Å.U.—D. Bigiavi. Action of peracetic acid on the acetyl derivatives of aromatic amines. The action of peracetic acid on aromatic amines yields the corresponding nitrocompounds, together with the azoxy-compounds. but similar treatment of the acetyl derivatives of the ammes gives the nitro-compounds alone.-G. Natta: Crystalline structure of the chlorides of tervalent metals (1.). Chromic chloride. This salt crystallises in the rhombohedric system and probably in the holohedral class, its elementary cell containing one molecule of CrCl, and having the side a = 4.42 Å.U. and the axial ratio c: a=1 29-1 30. The calculated density is 2.71—C. Perrier: Two recent notes by Philibert. The apparent biaxiality which may occur with Iceland spar when observed with the help of Federow's plate does not detract from the value of this plate when the segments are properly mounted. D Cattaneo: Ultramicroscopy of the crystalline lens (i.). The ultramicroscopic character of the lens (1.). normal crystalline lens. Ultramicroscopic investigation confirms Bottazzi's view that the protoplasm of the crystalline lens consists essentially of optically homogeneous material, but shows also that the crystalline fibres may contain a phase differing optically from such homogeneous material.

### Official Publications Received.

#### BRITISH

Aeronautical Research Committee. Reports and Memoranda No 1076 Comparison of Atalanta and Model sea Worthiness and Fore and Att Angle. By the Stafts of the Marine Aircraft Experimental Establishment, Felixstowe, and the William Froude National Tank, National Physical Laboratory (S. 33) Pp 9+6 plates (London. H M Stationery Office) is net Royal College of Surgeons of England Annual Report on the Museum, by the Conservator. Pp 28. (London) Annual Report of the Imperial Institute of Veterinary Research, Muktesar, for the Year ending 31st March 1926. Pp. 18 (Calcutta Government of India Central Publication Branch.) 8 annas, 10d Report of the Director-General of Public Health, New South Wales, for the Year 1925 Pp 11+207. (Sydney, N.S.W.: Alired James Kent.) 88.9d.
Scientific and Industrial Research Council of Allication Processing and Political Report of March 1986.

8s. 9d.
Scientific and Industrial Research Council of Alberta Report No.
18 The Bituminous Sands of Alberta Part I. Occurrence, Studied with respect to Commercial Development. By K. A. Clark and S. M. Blair. Pp. 74+7 plates. (Edmonton, Alba. W. D. McLean)
Trinidad and Tobago. Administration Report of the Conservator of Forests for the Year 1926. Pp. 19 (Trinidad, B.W.I. Government Printing Office, Port-of-Spain)
Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year 1926, with Report of the Director of Fuel Research. Pp. vi+62 (London. H.M. Stationery Office) 1s. 3d. net.

at Ministry Meteorological Office International Meteorological Organization Commissions for Terrestrial Magnetism and Atmrspheric Electricity and for the Reseau Mondial. Reports of the Meetings in Zurich, September 1926 (M.O. 296) Published by the Authority of the Meteorological Committee Pp. 34. 9d. net International Meteorological Organization Commission for Synoptic Weather Information (formerly Commission for Weather Telegraphy) Report of the Sixth Meeting, Zurich, September 9-16, 1926. (M.O. 293) Published by the Authority of the Meteorological Committee. Pp. 105. 2s. net (London H.M. Stationery Office)

Mines Department Publications of the Safety in Mines Research Board. Vol. 1, 1923, 1924 and 1925 Reports and Papers relating to Research into Coal Dust, Firedamp and other Sources of Danger in Coal Mines. Subject Index Pp. xiii. (London: H.M. Stationery Office)

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June 30, 1920 Pp 1v+105. (Washington, D.C. Government frinting Office)
Cornell University Agricultural Experiment Station. Bulletin 458: The Climate of Long Island; its Relation to Forests, Crops and Man By Norman Taylor. Pp. 20. Memoir 100. A Study of Pogoniris Varieties. By Austin W. W. Sand. Pp. 159+3 plates. Memoir 105. The Manufacture of Cheidar Chieses from Milk pasteurized by the Holder Method. By Walter V. Price. Pp. 36. (thaca, N.Y.)
Department of the Interior. Bureau of Education. Bulletin, 1927, No. 4 Bibliography of certain Aspects of Rural Education. (From January 1, 1920, to September 1, 1926.) Pp. vin+56. (Washington, D.C. Government Printing Office). 5 cents.
Bulletin of the National Research Council. No. 58: Handbook of Scientific and Technical Societies and Institutions of the United States and Canada. American Section compiled by Clarence J. West and Called Hull for the Research Information Service, National Research Council, Canada. Pp. 304. (Washington, D.C. National Academy of Sciences.)

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The Rockefeller Foundation. A Review for 1026. By George E. Wincent. Pp. 54. (New York City.)

Bulletin geodesique Organe de la Section de Geodesie de l'Union

Bulletin geodesique Organe de la Section de Geodesie de l'Umon Geodesique et Geophysique Internationale Annec 1925, No. 7, juillet, aout, septembre 1925. Pp 351 Thavaux de la Section de Geodesie de l'Umon Geodesique et Geophysique Internationale. Tome 2: Rapports generaux etablis à l'occasion de la Première Assemblée generale, Rome, 2-10 mai 1922. Pp vii+99+10+77+26+85+7. (Toulouse Edouard Privat, Paris J. Hermann.)

Year Book, The Academy of Natural Sciences of Philadelphia for the Year ending December 31, 1926 Pp. 116+7 plates. (Philadelphia, Pa.)

State of Illinois Department of Registration and Education Division of the Natural History Survey. Bulletin, Vol 16, Arts 5 and 6: An Experimental Investigation of the Relations of the Codling Moth to Weather and Climate, by Victor E Shelford, A Study of the Catalase Content of Codling Moth Larvae, by C. S. Spooner. Pp. 367-446. (Urbana, III)

(Urbana, III)

Konstørrelseforsøk Forsøk, undersøkelser og akttagelset til belysning av spørsmålet—stor- eller småkornet såvare i iplanteproduksjonen Av Prof Emil Korsmo (Særtrykk av Meldinger fra Norges Landbrukshoiskole, 1927) Pp. 76 (Oslo . Johansen and Nielsens Boktrykkeri) Smithsonian Institution Bureau of American Ethnology. Bulletin 82 Archeological Observations North of the Rio Colonado. By Neil M Judd. Pp ix+171+61 plates. (Washington, D.C. Government Printing Office). I dollar. (Urbana, Ill)

Radiography for the Dentist (Bulletin No 82.) Second edition. Pp 37. (Tondon Watson and Sons (Electro-Medical) Ltd )

### Diary of Societies.

#### CONGRESSES.

EMPIRE MINING AND METALIURGICAL CONGRESS

CONGRESSES.

Montreal Meetings, Jugust 22 and 23—Sir Thomas Holland. Proposed Review of the Mineral Resources of the Empire—G. M. Caltie and C S Pascoe Magnesia Refractories for Steel Furnaces —A Stansfield Smelting Titaniferous Iron Ores —W. A Toobey Portland Cement in Canada —Mining and Metallurgical Practice in Australia —Health Safety Problems

Toronto Meetings, August 25 and 26 —C Johnson Winning and Refining of Precious Metals from Sudbury Ores —R C Stanley Nickel, Past and Present —A A Cole The Silver Mining Industry of Canada —J G Morrow The Cascade Method of Pouring Steel —A Mavrogordato and H. Pirow Deep Level Mining Industry of Canada —J G Morrow The Cascade Method of Pouring Steel —A Mavrogordato and H. Pirow Deep Level Mining and High Temporations II unipped Meeting, September 3—G. E Cole The Development of Gold Mining in Canada —W. A Quince Methods of Eliminating Barren Rock from Ore at the Sub-Nigel Mine—C. R. Davis, J. L. Willey, and S. E. T. Ewing Notes on the Operation of the Reduction Plant at West Springs, Ltd.—E. J. La-chinger A New Form of Air Meter and the Measurement of Compressed Air Vancineer Metling, September 14—C. P. Browning: Canadian Copper and its Production—F. J. Alcock and T. W. Bingay, Lead and Zine in Canada—C. J. N. Jourdan. A Brief Review of the Principal Base Metal and Base Mineral Resources of the Union of South Africa. R. Crath. Dewatering the Lower Levels of the Simmer and Jack Mines, Ltd.—W. S. Robinson. Manufacture of Sulphuric Acid by the Contact Process. From Zine Blende Roaster Gases

Edmonton Meeting, September 20—R. Strachan, W. J. Dick, and R. J. I. e. The Coal Industry in Westein Canada—J. Ness. Petroleum in Canada—A Docquier, L. Bataille, and R. Beetlestone. A Combination of the Baum, the Draper, and the Froth Flotation Systems as applied to the Washing of Coal at the Linia Mining Administration, North China—A. E. Cameron. Impact Resistance of Suebe Meetings, September 5 and 26—J. G. Ross. Asbestos Mining and

Administration, North China—A. E Cameron. Impact Resistance of Steel at Low Temperatures Quebec Meetings, September 5 and 28—J. G Ross. Asbestos Mining and Miling—A. W Nash. Possible Auxiliary Sources of Liquid Fuel—A Job. The Sinking and Equipment of the Ventilation Shaft of the Government Gold Mining Areas—G W Sharp. The Tripping and Guiding of Vertical Skips—P. M Newhall and L. Pryce. Improvements in Drilling Efficiency with Jack-Hammers.

Sydney Meetings, September 9 and 10.—F W Gray. Mining Coal Under the Sea in Nova Scotia—Sir Robert Haddield. The Metal Manganese and its Properties also, the Production of Ferro-Manganese and its History—Raw Materials for the Iron and Steel Industry in India.—B Yaneske: The Manufacture of Steel in India, by the Dupley Process. Process.

#### SEPTEMBER 1-4

Schweizerische Naturforschende Geselischaft (at Basel) (in 14 Sections)—Presidential Address by Dr. F. Sarasin—Lectures on, iespectively, The Causes and Factors of Morphogenesis, by Prol. A. Brachet, Recent Work and Views in Astronomy, by Prof. L. Courvoisier, The Urals from the Point of View of Geophysics, Geology, and Mining, by Prof. L. Duparc, Paracelsus in Relation to Modern Thought, by Prof. H. E. Sigerist.

#### SEPTEMBER 4-9

INTERNATIONAL CONGRESS OF ZOOLOGY (at Budapest)

#### SEPTIMBER 11-17

INTERNATIONAL CONGRESS OF PHYSICS IN COMMEMORATION OF THE CENTENARY OF VOLTA (at Como).

#### SEPTEMBER 11-18

International Congress of Genetics (at Berlin).

#### SEPTEMBER 18-OCTOBER 3.

INTERNATIONAL CONGRESS OF THEORETICAL AND APPLIED LAMNOLOGY (AL. Rome)



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### British Woodlands.

THE seventh Annual Report of the Forestry Commissioners 1 recently issued summarises the work which has been accomplished in Great Britain up to Sept. 30, 1926. Interesting data are given of a census of the woodlands of Britain undertaken with commendable persistence by the Commissioners. This census has shown that the existing woods amount to 2,958,630 acres, less than half of which can be considered productive latter fact appears to have come as a surprise to the Commissioners. The few experts having a knowledge of the forestry conditions of Great Britain could have foretold the result with considerable certainty, and probably not a few of the proprietors also, in the absence of any expert knowledge to guide them

It was common knowledge that considerable areas were maintained as game coverts, questions of their value for timber production being entirely subordinated to the premier object. The late Sir William Schlich often directed attention to this fact during the forty years he advocated an afforestation campaign in Britain. The heavy fellings made in the utilisable coniferous areas during the War have admittedly intensified the need for an afforestation programme, but have scarcely changed it. The question still remains one upon which the Government and public, but chiefly the latter, must definitely make up their minds. The problem is a pressing one, but the costs of afforestating the several million acres which the experts are unanimous in admitting can be made more productive under trees will be very much higher than would have been the case had the work been done before the War. The present sanctioned programme comes to an end in 1929, and the Commissioners, in the report under review, express anxiety as to the continuance of the work and advise that it should be carried out on an enhanced scale. The report, in fact, is far more than a mere enumeration of the work of the year. It is more concerned with placing before its readers the work achieved to date and the lines upon which, in the view of the Commissioners, the next ten-vear programme should be drawn.

The arguments for and against the enhancement of the afforestation programme are weighty; for the true interests of the country, economic and otherwise, support the plea of the Commissioners for an enhanced programme. Those against are

<sup>1</sup> Forestry Commission. Seventh Annual Report of the Forestry Commissioners, Year ending September 30th, 1926. Pp. 45. (London: H M. Stationery Office 1927.) 1s. net.

chiefly concerned with the great expense involved, and the added factor that an experienced forest service has vet to be built up. After the wars of a century ago, prices remained high for a considerable period and gradually dropped. It may be hoped that the future, how distant none would dare to say, will see a similar reduction. This would mean that plantations now being made at £5:16s. to £7:10s. an acre might cost only half the amount. The cost of buildings, etc., for small-holdings would likewise be reduced; and so forth throughout all the various branches of forest work. Up to Sept. 30, 1926, 186 small-holdings (the average cost of 63 new buildings during 1926 was £623 apiece) had been completed. It is hoped that 750 small-holdings will be completed or in process of establishment (the limit in sanctioned cost is £800 apiece) by the end of 1929. It is stated that their number could be increased to 3000 or 4000 in the next ten-year period. The Commissioners admit that they have only had two and a half years' experience of this Experts in Great form of rural settlement. Britain disagree as to whether such a form of settlement is practicable. It is a common method in France; but small-holders there work 10 hours a day as a minimum during the spring and summer and are far thriftier than our people

The cost of 'planting' is shown in a curious way in the Report. All expenses during the first year of formation, including weeding, are termed the cost of 'planting.' If 50 per cent. of the plants fail and have to be replaced, this operation is shown under 'establishment' of the plantation. Presumably if the whole of the trees under 'planting 'failed, the replanting of the plantation would be shown under 'establishment,' a somewhat complex puzzle to set the forest officer in charge, say, fifty years hence. The Report shows (Table E 5) that during the seven years £132,767 were spent on planting and £35,061 on 'beating up,' i.e. replacing failures in the plantations. This amounts to something more than 25 per cent. failures in the first plantings. For 1926 the figures are £28,621 and £13,071, slightly less than 50 per cent. failures. No private proprietor could afford to plant if 'beating up' on this scale had to be faced. It is scarcely a justification for speeding up the planting campaign during the next ten years, which is so warmly advocated in the Report.

That much good work has been accomplished by the hard-working officers of the young service under the Forestry Commissioners is undeniable. That experience can only come with increased knowledge and practice is equally undeniable.

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### Modern Alchemy.

Atomzertrummerung: Verwandlung der Elemente durch Bestrahlung mit o-Teilchen. Von Hans Pettersson und Gerhard Kirsch. Pp. viii + 247. (Leipzig: Akademische Verlagsgesellschaft m.b.H, 1926.) np.

THE artificial disruption of many of the chemical elements can be regarded as a direct outcome of the study by Geiger and Marsden of the scattering of a-particles by matter, and the formulation, in 1911, of the nuclear theory of the atom by Sir Ernest Rutherford. Theoretical work of Darwin on collisions of a-particles with the nuclei of atoms was supplemented by the experimental work of Marsden and Lantsberry, who discovered the production of H-rays in hydrogen when a-particles collide with the nuclei of hydrogen atoms. The later development of this work by Sir Ernest Rutherford revealed the production of H-rays when nitrogen is bombarded by a-particles, and in this we have the first instance of the artificial disintegration of an element by a-rays.

Since 1919, the subject has been actively pursued by Rutherford and Chadwick in the Cavendish Laboratory at Cambridge, and the ejection of H-particles from the nuclei of many of the lighter elements has been established, the effects being most marked for elements of odd atomic number. Unfortunately, experiments of this nature require the use of appreciable quantities of radium, and this undoubtedly accounts for the fact that so fascinating a study has not been taken up in many more laboratories. In 1922, however, the authors of the present monograph commenced work on similar lines at the Vienna Radium Institute, which, since it was opened in 1910, has been an active centre of radioactive research, and possesses ideal facilities for such work. During the last five years these workers have gathered together a band of enthusiastic researchers, who have made valuable contributions to the subject under consideration.

As a result of the investigations carried out at Cambridge and Vienna, our knowledge of the effects of a-bombardment of the elements has reached a state which justifies the appearance of a monograph of the type under review. In writing it, the authors' aim was to arouse the interest of physicists in this fascinating branch of research, and to stimulate others to take an active part it its development. But, alas, the lack of strong radioactive preparations is a real difficulty. To those who are more fortunately placed in this respect, however, the book will be found of great

value in making readily accessible not only the experimental methods and results, but also their interpretation. The number of substances so far investigated is relatively small, and the methods of attack used at Cambridge differ in many respects from those used at Vienna. In consequence, the results obtained in the two laboratories are not always directly comparable, and in some respects show lack of agreement. Nevertheless, the authors have endeavoured to be impartial in their treatment, and science owes them a debt of gratitude for presenting such an excellent review of the subject.

In the opening chapter the question of transmutation in general is treated historically, and the authors wisely refram from a discussion of recent claims in this field. We are then introduced to the main properties of a- and H-rays, and pass in review the relevant theory and the experiments carried out to test the validity of the nuclear theory 'of the atom. Chapter iii. deals with the earlier experiments on atomic disruption carried out at Cambridge and Vienna, and discusses the results of investigations on the \alpha-particles of long range emitted by the C-products of radium and thorium. By the introduction of the method of observation of the atomic fragments in a direction perpendicular to that of the bombarding a-particles, it became possible to count scintillations much nearer the source of disruption, for both the number and range of the scattered a-particles are greatly reduced in this way. This method has been successfully applied both at Cambridge and Vienna, and the various results are given in the same chapter. The results of observations in the backward direction by the 'retrograde' method are also described This method has been extensively used at Vienna and permits of a still closer approach of the counting screen to the material under examination. more recent investigations on collisions with the nuclei of atoms are reviewed in Chapter iv.

Since the intensity of the scintillations produced by a-particles falls off considerably near the end of the range and the brightness of H-scintillations is much less than that of scintillations due to normal a-particles, the correct allocation of feeble scintillations is often a matter of difficulty. Pettersson and his co-workers have developed the technique of identification by direct comparison of a- and H-scintillations, and this is described in Chapter v., where an interesting account of the photographic action and absorption of H-particles is also given. This chapter also contains a description of Stetter's ingenious adaptation of the mass-spectrograph, by means of which the value e/m =

9560 ± 300 was found for the H-particles from paraffin wax. Chapter vi. is devoted to the various unsuccessful attempts which have been made from time to time to influence the rate of decay of radioactive substances, whilst the following chapter deals with various theoretical considerations on such topics as nuclear collisions and the size of the nucleus. For any one contemplating work on the subjects of this volume, Chapter vin. is a veritable mine of useful information It contains most valuable details on the preparation of sources of radiation, the application of the scintillation method, the optical devices used in work on disruption, the preparation and calibration of absorption screens, and other matters of technique. The book closes with an interesting chronological review of the work on atomic disruption, and a complete list of the relevant references to the literature.

From the results of the Vienna workers, the phenomenon of disruption by a-particles would appear to be of much more general applicability than the Cambridge results indicate. Moreover, whereas the latter school finds that disruption is not effected by a-particles of smaller range than about 4.9 cm., the former claims to have obtained positive results with a-particles of range less than 4 cm. (e.g. with polonium). The yield of H-particles found in Vienna is also considerably greater than that found at Cambridge. Such discrepancies do not appear surprising when we consider the great strain associated with the counting of such feeble scintillations as those produced by H-particles, so clearly revealed on p. 225 of the book under review.

It is unfortunate that observations have usually been made on the side of the scintillation screen remote from the zinc sulphide surface, as this must involve a distinct diminution in the brightness of the flashes, and render counting more difficult and less certain. Naturally, both schools have great faith in their own results, and whilst Kirsch and Pettersson have obtained evidence that the observed differences are attributable to the different optical arrangements used, Chadwick has directed attention to the difficulty of ensuring the absence of scattered a-particles of low velocity in experiments at short range. In our opinion, the position of the Viennese workers has been greatly strengthened by their more recent confirmatory evidence obtained by other methods, and it is to be hoped that before the appearance of a second edition of this valuable book the existing discrepancies will have been satisfactorily removed, and the main features of this fascinating subject firmly R. W. L. established.

# The Breeding and Rearing of Farm Animals.

Breeding and Improvement of Farm Animals By Prof. Victor Arthur Rice. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xiv + 362 (New York. McGraw-Hill Book Co, Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 17s. 6d net.

T is becoming more and more realised that it is a matter of primary importance to the stockbreeding industry to possess an understanding of the processes of reproduction and development. Of our existing knowledge of this subject in its relation to the breeding of farm animals, some was acquired long since by direct practical experience and has been handed down for countless generations. It follows that such knowledge, although generally sound-for otherwise it could scarcely have stood the test of time-was necessarily limited and uncorrelated, for it existed without reference to scientific system and is not founded on scientific principles. In recent years, however, a great deal of attention has been paid to the science of breeding, and although it cannot be said that research methods have led as yet to any spectacular developments of economic importance, nevertheless a great number of observations have been made and deductions arrived at which in the aggregate are already having an important effect upon practice.

The present volume has been written as a text-book on the breeding and rearing of farm animals. While it is in many respects severely practical, the author has succeeded in giving it a definite scientific bias, and much of the recently acquired knowledge which has been won by physiological and genetic investigation is duly included. Moreover, by giving a connected account of the different departments of the subject, the author points the way to further progress in the improvement of the various classes of stock.

The opening chapter, among other matters, deals with the derivation and history of the domestic animals, and the author, in common with other writers, takes the view that most of the species have had a multiple origin, but Prof. Ewart's extended researches on this subject are not alluded to. Chapter ii is on the physical basis of inheritance, and the chromosome theory is adequately described. Here the author definitely identifies the genes or factors with the 'beads' which comprise the chromosomes. In a later chapter he goes even further and suggests that the genes are either proteins or enzymes (or both), merely making the

reservation that "it is not known" which of the alternatives is true. Such a statement is much too crude for a scientific text-book, and we fail to see what advantage is gained, in the present state of knowledge, for any theory of heredity by identifying the mechanisms of transmission with definite chemical compounds or agencies.

The third and fourth chapters contain useful descriptions of the male and female genital organs. and the processes which occur in them, but the almost complete absence of any account of the cestrous cycle is a strange omission in a text-book on animal breeding. Such information as is given is confused and contradictory. Thus, the author quotes Williams as saying that "if a cow is bred during a heat period and does not conceive she will subsequently menstruate, while if she does conceive she will not menstruate" Here Wilhams's reference to 'menstruation' was clearly intended to refer to the sanguineous discharge which sometimes takes place shortly after cestrus and really represents the termination of the preceding cestrous cycle. Prof. Rice, however, in the very next sentence proceeds to state that "the menstrual period lasts for about 24 to 48 hours in cattle," etc. and that "this is a most important season, because it is apparently only during this time . . . that a mare, cow, ewe, or sow can be successfully impregnated." The use of the term 'menstruation' as synonymous with cestrus is quite unjustified

In the next chapter, on fertility, there is some further allusion to the estrous periods (p. 54), but the distinction between the monestrous and polycestrous conditions is not drawn and there is no reference whatever to the short (diæstrous) cycle either in pigs or sheep. This is also omitted in the summary of the "Chronological Order of Reproductive Processes" (p. 47), where we find a further confused statement as to menstruation (in cattle). Again, it is not correct to describe the absorption of the corpus luteum as occurring at a later stage of the cycle than "nutrition of young." It is a mistake also to describe the vasa deferentia as the homologues of the Fallopian tubes, as these have a different origin in embryonic development. There is an interesting description of the American work on the vitality of the ova and the spermatozoa, but no account is given of Hammond's more extended investigations published in 1925, and the author does not appear to realise the practical possibilities of transmitting semen from a distance or the importance of what has actually been accomplished.

The succeeding chapters on sterility and reproductive efficiency deal with many matters of

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practical importance besides pointing the way to further lines of work. It is interesting to note that some of these (for example, the question of the time of ovulation in the mare) have already been taken up. The sections dealing with parturition, genetic problems, grading, inbreeding, etc., are also full of interest, and the analysis of the show-yard records of the leading animals of different breeds contains much information which is not otherwise readily accessible. The chapter upon the development of farm animals includes many useful hints as to management and feeding. The last chapter, entitled "Fitting for Sale and Selling," is entirely practical, and directs attention to sundry matters of importance to every breeder who would market his products successfully

The book is well illustrated, many of the figures being photographs of outstanding specimens of farm animals. There are appendices on biometry and inheritance in horses, cattle, etc., besides a list of Pedigree Register Associations and a bibliography of references. In the second edition, which ought soon to be called for, these should be made more complete and the results of the latest researches incorporated.

F. H. A. Marshall.

### The Mathematics of Intelligence.

The Abilities of Man. their Nature and Measurement. By Prof. C. Spearman. Pp. viii+416+xxxiii. (London. Macmillan and Co, Ltd, 1927) 16s net.

ROF SPEARMAN'S new book, embracing his researches for some years past, is an exceedingly difficult book to review, and this for more than one reason In the first place it is distinctly written for the layman, and he is expected to take many things on faith to trust Prof. Spearman's mathematics and still more Prof Spearman's arithmetic. Now we can scarcely call upon the author of a popular book of this nature to justify either arithmetically or mathematically all his statements, but we do think that without overcrowding his pages he might have given us more of the numerical data on which his conclusions are based, so that we could test their adequacy without an immense amount of labour. This point is all the more to be emphasised because Prof. Spearman claims to have made by his investigations a "Copernican revolution in point of view." He tells us that he has "not - as all others - set out from an illdefined mental entity the 'intelligence' and then sought to obtain a quantitative value characterising this. Instead, we have started from a perfectly defined quantitative value g, and then have demonstrated what mental entity or entities this really characterises g (p. 411)

Now in order to test the justification for this statement that a Copernican revolution has been made in the study of the human mind, it is certainly needful to check not only the arithmetic but also the mathematics on which the claim is based, and neither of these are light matters, especially in such a brief review as this must necessarily be. But without some reference to the mathematics of the subject the real basis if our author's Copernican revolution cannot be rendered clear, nor without some arithmetic can we determine whether the values he gives are to be accepted straight off.

With much of the author's criticism of the definitions of intelligence hitherto proposed, we must undoubtedly agree: it is ably and amusingly written But Prof Spearman escapes any like criticism of himself by giving no definition of intelligence at all. He hypothecates that the measurement of a mental ability  $(A_n)$  is a function of two factors, a general factor g and a specific factor  $s_n$ , the former being a factor of all a person's mental abilities and the latter varying from ability to ability g is independent of the  $s_n$ 's, and the latter are independent of each other. Mathematically

$$A_n = \phi (g, s_n)$$

where  $\phi$  is a function as yet undetermined Prof. Spearman then proceeds to replace this general functional relation by a purely linear one, he in fact writes

$$A_n = c_0 + c_1 g + c_2 s_n$$

and all his conditions and his treatment depend on this linearity. Now the mind is a complicated organism, and quite as complicated as many physical phenomena, which do not obey any such linear relationship. What real justification is there for the adoption of such a form?

"The answer to this question is that our proof has depended upon usage of Taylor's theorem, according to which all mathematical functions, however complex, can, in general, be expressed in the above simple additive form with some approximation. This theorem has supplied the main foundation for the whole theory of correlation, from the original work of Bravais onwards; indeed, it is among the main props even of physics" (p. xv, Appendix).

We do not know how many physicists would agree with such a statement, but we presume that if they have adopted a linear relation, it is because it has been demonstrated experimentally to hold within some limited range. In the same way the only justification for linearity of regression is not Taylor's theorem, but observation and experiment. With our knowledge of the innumerable cases in which regression is non-linear, it is neither possible to assert that linearity is the main foundation of the whole theory of correlation, nor to accept it without foundation on experiment as a justification. Some light might have been thrown on the matter had Prof Spearman provided a distribution of g's for a population of reasonable size.

Accepting for the time this linear relationship, what flows from it? Without doubt, if a, b, c, d are four measurable abilities, the vanishing of what Prof. Spearman terms their tetrad differences, i.e.:  $r_{ac}r_{bd}-r_{ad}r_{bc}=0.$ 

Of course, in actual statistics this vanishing will depend upon the error of random sampling of a tetrad, and ultimately this error depends on the number (p) of individuals on which the correlations have been based. When p is small and the correlation r is large, the distribution of r does not follow the normal curve of errors, it is very far indeed from doing so. Correlations as high as 0.60 based upon 37 individuals deviate widely from the normal law, and many such occur in the chapter entitled "Proof that G and S exist." But whether the distribution of correlations be normal or not, it is perfectly certain on the basis of Prof. Spearman's own data that the distribution of tetrads is not normal. What it really is, even if the original mental ability correlations followed a normal law, no one at present knows. We are simply ignorant, and it is impossible to consider that any confirmation of the theory of two factors can be reached by placing a normal curve on top of the distribution of tetrads and judging merely by the eye of the goodness of fit. For example, the most ample data discussed by Prof. Spearman are those of Holzinger, involving 378 tetrads, and those of Simpson involving 3003 tetrads. If we apply to these distributions the normal curves for the theoretical standard deviations of these systems of tetrads, i.e. the actual values, not those computed by the approximate formulæ of Holzinger and Spearman from the mean correlation, we find for the first distribution, only one random sample in ten would be as bad a fit to the normal curve, and again for the second, that not one random sample in a million would give as bad a fit. Now we do not complain of these distributions failing to be normal curves, because we hold that

they ought not to be But we do complain of Prof. Spearman assuming them to be normal distributions, and using this as an argument in favour of his two-factor hypothesis. Indeed, afterplacing a normal curve on his data in the last case, Prof. Spearman writes (p. 146)

"This time, the two distributions, curve and rectangles, far from being totally discrepant as before, display instead one of the most striking agreements between theory and observation ever recorded in psychology Indeed, it would not be easily matched in any other science."

These words seem unfortunate not only because of the high improbability of the curve fitting the data, but also because there exists no theoretical reason why it should do so

Prof. Spearman starts with rendering his distribution of tetrads symmetrical, i.e making each tetrad once positive and once negative Hence he naturally has something that looks like the familiar cocked hat shape of the curve of errors Further. he can in this manner reach no test whatever of whether they are zero within the limit of random sampling. He has made his mean tetrad difference value zero artificially For Simpson's data the diagram has attached to it a scale lettering, in which 0.020, 0.030, 0.035 are printed where we ought to have 0.20, 0.30, and 0.35, that is, the tetrad differences are accidentally, but very unfortunately, given one-tenth of their true values, and accordingly appear very small. Underneath the diagram we read: Probable error == 0 061, Observed median = 0.062This latter is the only real test provided of the agreement of theory and observation It is not quite clear how Prof Spearman has obtained these figures The actual theoretical mean value of the 3003 squared tetrads is 0.007,887 corresponding to a theoretical standard deviation of 0 088,809, or if we use the term probable error, although the distribution is not normal, we have the value 0 059,901 instead of Prof. Spearman's 0.061. If we understand by Observed median, the observed quartile of the symmetrical tetrad difference distribution, it is 0.0581, not 0.062 as given on p 146. The question would then be whether 0 060 and 0 058 are in good agreement But a better way to approach the problem is probably to note that the theoretical mean squared tetrad is 0 007,887, while the observed value is 0 009,817 The difference between observed and theoretical mean is thus 0 001,930 If we could measure the probable error of the mean in the usual way on 3003 observations with a standard deviation of 0.017,769, it would be 0.000,219, or the deviation would be some 8.8 times the probable error. We should accordingly conclude on these data that the new Copernican theory, so far from being in "striking agreement" with observation, signally failed.

While, however, we know the theoretical mean squared tetrad value—always, alas' on the basis of variates following a normal distribution—we do not know the true probable error of this squared tetrad value. The reason for this is that the tetrads are not like the individuals of an ordinary frequency distribution merely correlated by the fact that the size of the sample is fixed. On the contrary, there is correlation produced by the fact that in this case the 3003 tetrads are functions of only 91 individual correlations, and this correlation is very high in the case of the triplet of tetrads based upon sets of four correlations. To determine the true probable error of the sum of the squared tetrads will be a problem which will task the ablest mathematician, even if he assumes (i) that the original mental variates follow the normal law and (ii) that the correlation coefficients follow-which we know they do notthe same law. At present no one can say whether or not the sum of the squared tetrads differs from its theoretical value by amounts which can be accounted for on the basis of random sampling. But we can say that what Prof Spearman considers proofs of his theory are not proofs, and that much mathematical work remains to be done before we shall even be in sight of a proof With the failure of Chapter x., that is, "Proof that G and S exist," the very backbone disappears from the body of Prof. Spearman's work. Even if the correlations of mental abilities were taken to vary at random with a given standard deviation round a given mean, the distribution of the resulting tetrads would form an approximately normal system, and many tetrads would vanish or nearly vanish; it would be idle to pick these out as special illustrations of But this is m fact what occurs in the later chapters of "The Abilities of Man"

We have confined our criticisms to one point: there are others, especially in the mathematical appendix, where we hold Prof Spearman's analysis to be defective. But it seems to us that there is one main question. Is the experimental proof of the existence of a general and of specific factors on which the author bases his discussions in this work valid? Prof. Spearman holds that it is, we hold that it is not. The truth can only be ascertained by lengthy arithmetical and mathematical investigations, unsuited to a review of the present kind.

One advantage of the publication of this book

will be that the attention of mathematicians will be directed to the real difficulties of the analysis, and this should lead, in conjunction with the psychologists, to a fitting series of tests in which probably some fifteen to twenty abilities should be measured on four or five hundred individuals. In particular, the abilities must be selected beforehand, and none rejected after analysis because they do not satisfy the condition of zero tetrad difference. Prof. Spearman has had the merit of directing attention to the subject, but his book will do more harm than good if it leads the non-mathematical psychologist to believe that the author has proved his hypothesis. It may possibly turn out to be true, but the proof will have to be far more rigid than anything so far provided in "The Abilities of Man."

### The Exploitation of Tropical Africa.

An African Eldorado: the Belgian Congo By T Alexander Barns. With an Introduction by Sir Louis Franck. Pp xv+229+23 plates+4 maps (London: Methuen and Co, Ltd., 1926) 15s net

Out in the Blue. By Vivienne de Watteville With a Preface by the Hon. William Ormsby-Gore. Pp. xvi+254+65 plates. (London · Methuen and Co, Ltd., 1927.) 18s. net.

HESE two volumes deal with two different aspects of the exploitation of central Africa. Mr. Barns is chiefly concerned with the development of the mineral and agricultural resources of the Congo basin, particularly those parts under Belgian control. Miss de Watteville sees tropical Africa through the eyes of a naturalist. Mr. Barns paints an illuminating picture of the fertility of tropical soil, the scope for the development of the wealth of its natural vegetation, its metalliferous ores and precious stones, and indicates the respective rôles of the white man and the native in this development. Miss de Watteville's only concern is the exploitation of the fauna of the tropics in the interest of the Berne museum, by the authorities of which she and her father, the late Bernard de Watteville, were commissioned. Within the compass of 225 pages Mr. Barns deals with most of those aspects of African life and travel which interest most of us, whatever our peculiar interest may be, whether geology, botany, zoology, history, or anthropology. Miss de Watteville devotes the same amount of space to a straight tale of systematic killing of wild animals and the preparation and preservation of their hides for a museum.

Lingering yet in our memory is the account given by the late E. D. Morel of the horrors of the Leopold regime in the Congo, an account which aroused the peoples of Europe to effective protest Now, according to Mr. Barns, Belgian administration in the Congo is characterised by as much regard for the welfare and progress of the natives as the British administration in West Africa Louis Franck, former Belgian Colonial Minister, who contributes a preface, describes the official attitude thus: "We believe in the progress and future of the black man, and we want to pave the way for him towards a better standard of life, a great improvement in health and efficiency, and a . We are absolutely opposed higher civilisation. to anything like colour bar or race discrimination in the opportunities offered to black labour"

The difficulties of the Belgian administrators are common to all aliens in tropical Africa faced with great difficulties of communication which the mighty waterways do not altogether surmount, with multitudinous insect pests—a constant menace to man and beast—the conservatism of the natives, the diversity of tribes and languages, pygmies in close proximity to giants, and the shortage of capital. On the other hand, they have certain special advantages. "All its eggs are in one basket." The upturned edges of the basin of the Congo are a storehouse of mineral wealth in amazing abundance, while in the well-watered plains the oil-palm, rubber, rice, cotton, sisal, and other economic plants flourish, and there is rich pasturage for cattle on the slopes of the basm In the south there are mountains of copper in the Katanga Copper Belt, with gold, tin, radium, and cobalt in close juxtaposition. In the Mandated Territory of Ruanda, on the east of the Rift Divide, is one of the most populous and richest cattle countries in Africa, the cattle possessing the advantage of immunity from East Coast fever. In the north-east are the Kilo and Moto gold mines, and again to the south, in the Kasai, extensive diamond fields are being worked. On the material side, therefore, Mr. Barns regards the Belgian Congo as "an Eldorado," a country which promises a rich return for men of small means as well as for development companies with large financial resources.

The main interest of this arresting volume lies, however, not so much in the author's description of the material resources of the country, as in his description of the scenery, of the peoples, their habits and customs, their arts and crafts, of the flora and fauna, and his incidental notes, some of which are of particular interest to scientific

workers. For example, in the high country in the Kıvu craterland, there are no tsetse-fly, but the cattle suffer from tsetse-fly disease In the flydistricts around Lake Edward and along the Semliki river, man and his domesticated live-stock have managed to hold their own against the epidemics of nagana and sleeping-sickness that have so often ravaged the district. The African elephant, he tells us, "is very free from disease. can thrive at all elevations from the sea to 13,000 feet (the equatorial snow-line), can stand alike either cold or heat and can obtain nourishment from a greater variety of vegetation than any other animal" Mr Barns's book, with its beautiful photographs, will add to his already considerable reputation as a charming and accurate observer of the Africa he loves.

To those who are interested in the details of a 'collecting' expedition, and wish at the same time to read an amazing story of a girl's pluck and persistence after the tragic death of her father in an encounter with a lion, Miss de Watteville's book can be recommended.

A. G. Church.

#### Our Bookshelf.

The Chemistry of the Natural and Synthetic Resins.

By T. Hedley Barry, Alan A Drummond, and
Dr. R. S Morrell. (Oil and Colour Chemistry
Monographs) Pp. viii + 196. (London: Ernest
Benn, Ltd., 1926.) 21s. net.

This volume is divided into two sections, dealing respectively with the natural and the synthetic resms. Perusal of the former of these sections gives the impression, only too correct, that our knowledge of the chemistry of the natural resins consists mainly of information concerning botanical sources, methods of collection, and of a few variable 'constants.' Practically only in the case of colophony, the commonest resin, has any approach been made towards elucidation of the chemical constitution of complex bodies present in these natural products; it is not surprising, therefore, that the author has allotted to this particular topic one-third of the space in this section.

Following a brief account of the botanical origin and nature of resins by Dr. Willis, the first two chapters deal with general physical and chemical properties. Only resins of interest to the varnish maker are considered, and these are classified under the following headings hard and semi-hard resins, spirit-varnish resins, colophony, soft resins, true lacquer, and shellac.

Despite systematic attempts at the conservation of sources of supply, the partial exhaustion of the natural resin constitutes a danger which should not be overlooked; the introduction of the synthetic resins, therefore, is most timely. Although our knowledge of the chemical processes involved has lagged behind the technical side of the subject, investigations during the last few years have afforded considerable insight into the various causes and stages of resimification; these are well set out in the volume under notice. The synthetic resins, other than those obtained by treatment of the natural varieties (e.g. by esterification of colophony and copal) which are also dealt with in this section, fall broadly into two classes, the condensation resins and the polymerisation resins. These are considered under their respective headings, other products, such as the treated phenol-formaldehyde resins and those from urea and thiourea, are considered separately. The section concludes with a brief chapter on the methods of testing synthetic resins

The book covers a very large field, and certainly presents in modest bulk a useful summary of our present knowledge of the products discussed. The index is adequate, although one or two omissions have been noted. Unfortunately there is an unduly large proportion of misprints, mainly in the first section; names mis-spelled in the text persist in the index, whilst some references are incorrect

B. A. E.

Spectroscopy. By Prof E C. C Baly. (Text-books of Physical Chemistry) Third edition In 4 volumes Vol. 2 Pp vin + 398 + 3 plates (London: Longmans, Green and Co, Ltd, 1927) 18s net

PROF. BALY'S well-known work on "Spectroscopy," which formed a single volume in the first edition of 1905, as well as in the second edition of 1912 and 1918, has now begun to grow so rapidly that the third edition is to appear in four volumes instead of the two volumes that were originally contemplated. This expansion is an almost inevitable sequel to the amazing growth of the subject since Bohr first introduced the quantum theory into spectroscopy in 1913; and no one will grudge the author more space in which to expound the wider knowledge that has been gamed during the subsequent years. These topics, however, are not included in the present volume, which contains only one indexed reference to Bohr, and none to the quantum theory

The subjects dealt with are: (i) interference methods, (ii) methods of illumination, (iii) the nature of spectra, (iv) fluorescence and phosphorescence, (v) the photography of the spectrum. Thus a detailed account is given of the use of an interferometer in the study of double stars, with diagrams of the apparatus used at Mount Wilson, which look rather like a 'Meccano' model, until it is seen that the beams are made from 10-inch and 12-inch steel channel The methods of illumination range from flame spectra to the 'explosion' of wires by means of a condenser discharge. The chapter on the nature of spectra deals mainly with the structure, width, and sharpness of the lines, e.g. the resolution of the green mercury line into a dozen components and the classification of these components into three triplets and three remaining unrelated lines. The chapter on fluorescence and phosphorescence covers a wide field, including Wood's work on resonance spectra and on fluorescence, the work of the two Becquerels and of Nichols and Howe on the fluorescence of uranyl salts, Stewart's experiments on Tesla luminescence spectra, and a large amount of work on phosphorescence and luminescence of various types. The final chapter on photography includes a considerable amount of information supplied by Dr. Kenneth Mees, and also a section on sensitisation written by him.

The author is to be congratulated on completing his second volume, and preparing the way for the description in Vol. 3 of those modern developments which have given to spectroscopy a predominant position in atomic physics, comparable to that which it held when Bunsen first applied the spectroscope to the study of the chemical elements.

Über die Natur und Bildungsweise der mannen Eisensilikate, insbesondere der chamositischen Substanzen · ein Beitrag zur chemischen und mechanischen Sedimentation. Von Dr. Karl C Berz. (Fortschritte der Geologie und Palaontologie, Heft 11.) Pp viii +365-522+6 Tafeln (Berlin: Gebrüder Borntraeger, 1926) 12 gold marks.

During recent years considerable progress has been made in the description of ferriferous sediments. Works by Hayes on the Wabana iron ore (1915), by Cayeux on the French secondary ores (1922), and by Slavik on the Czechoslovakian deposits have contributed substantially to the elucidation of the chamosite-bearing rocks, while corresponding researches have been carried out on the English iron ores by the Geological Survey of Great Britain since 1920 (see "Summary of Progress for 1922" (1923), and Special Reports, vol. 29 (1925)). The present work contains a review of this question on similar lines to the above, dealing in some detail with the German deposits. The author limits himself to the discussion of existing literature on the subject, with a few additional descriptions, and provides a useful account of many rather inaccessible papers on local ores. In dealing with general literature the author has evidently been somewhat at a disadvantage, for of the works above mentioned not one appears in the bibliography, though there is passing reference in the text to the report by Hayes.

The views advanced are substantially in agreement with those generally current, the ores being regarded as primary sediments. Interesting sketches are given of the tubular organisms sometimes found in the ooliths; the author does not regard them as having played an essential part in the formation of the oolith, but rather as parasitic growths accidentally preserved in the inorganic structure. Chamosite is described in detail from the mineralogical viewpoint, but the corresponding account of glauconite is scarcely adequate, and more space might perhaps have been given to the discussion of the glauconitic sediments. As is perhaps inevitable in a work of compilation, the tone of the discussion appears somewhat speculative,

for the origin of these rocks has been the subject of a great variety of conflicting theories, but many useful observations are recorded. The microstructures are illustrated by twelve photographs of chamositic sandstones and colitic ores from French, Belgian, and German localities.

A Survey of American Chemistry. Vol. I.: July 1, 1925, to July 1, 1926, including Reports from Scientific Committees, Division of Chemistry and Chemical Technology, National Research Council Edited by William J. Hale, in co-operation with Clarence J. West (Published for National Research Council.) Pp. 257. (New York: The Chemical Catalog Co., Inc, 1927.) 2 dollars

This compilation will afford actual assistance to chemists in so far—only so far—as its prearranged national limitations have been ignored by the authors of its thirty-four chapters. Summaries of the literature of chemistry are increasingly acceptable to the chemist, whether investigator, teacher, or student, provided that it may reasonably be supposed that relative scientific value is the only criterion of the consideration or rejection of subject matter. Moreover, the student of American history would obviously be better served if he could be provided with some means of ascertaining whether the numerous reports of investigations which are here admirably chronicled and discussed were as American in origin as the name of the journal in which they appeared would indicate; if, too, he could gauge the extent of the lacuna represented by the publications of Americans in European journals. It will be obvious, also, that the granting of a patent is no guarantee that the work is indigenous.

In any case, both chemists and historians will regret the absence of an index; not even a list of authors is provided. In some chapters, however—the net is spread very wide over pure and applied chemistry—it is evident that an attempt has been made to present a summary not only of considerable interest but also of permanent value. A. A. E.

Gmelins Handbuch der anorganischen Chemie.
Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System-Nummer 19: Wismut und radioaktive Isotope. Pp. xxii + 229. 33 gold marks. System-Nummer 20: Lithium. Pp. xxiv + 254. 37.50 gold marks. (Berlin: Verlag Chemie G.m.b.H., 1927.)

THE parts of Gmelin's new "Handbuch" which deal with lithium and bismuth, like the earlier parts, show abundant evidence that a painstaking and exhaustive review of the literature up to July 1926 has been made. Following the general plan of the work, the parts open with notes on the history and distribution of the elements. Then follows a comprehensive survey of their physical, electrochemical, and chemical properties, and a similar scheme is adopted in dealing with compounds of these elements with such other elements as precede

them in the scheme (see Nature, Mar 5, p. 346). That the search through the literature has been thorough may be inferred from the fact that the description of one salt alone (lithium chloride) occupies fifty pages and contains detailed numerical data relating to hydrates, to solutions in water and in organic solvents and to complex amminechlorides. A summary of recent work on the atomic dimensions, atomic structure, and isotopes of lithium is given, whilst the radioactive isotopes of bismuth are fully described in a special section, which includes not only detailed references to recent papers but also a synopsis of the general literature on the subject.

Ancient Egyptian Materials. By A. Lucas. Pp. viii + 242. (London: Edward Arnold and Co, 1926.) 7s 6d. net.

In his preface Mr Lucas points out that it is only in recent years that the archæologist has availed himself of the assistance of the chemist. With certain reservations this is correct, and it is true that a great deal of detailed work has still to be done. A reference to the sections in the present book which deal with the use of metals will show to what an extent questions relating to the source and early history of copper and bronze must remain in suspense until analyses of specimens of these materials from early sites and early workings have been made. Whence came the tin which was imported into Egypt? Mr. Lucas thinks that it may have been Spain, and inclines to the view which relegates Cornwall as a source of copper to the Middle Ages. If the edict of Sargon is correctly interpreted as referring to a "land of tin," this would give a mention of that metal earlier than that in Homer quoted by the author; but Spain seems a far cry from Mesopotamia at so remote a date as 2750 B c.

This is one only of a number of problems which is raised by Mr. Lucas's book. Each of the materials used by the ancient Egyptians is taken in turn and described, its nature or composition examined, and its use, and wherever possible its place of origin and the date of its first employment given. Appendices deal with chronology and, what will prove especially helpful, give a number of analyses of metals and other materials. One point brought out very clearly by this method of treatment is the indebtedness of Egypt to western Asia.

The Aborigines of the Highlands of Central India. By B C Mazumdar. Pp. vi+84. (Calcutta: The University of Calcutta, 1927.) n p

This is a small but valuable contribution to our knowledge of some hill tribes in central India. The author, who is lecturer in cultural anthropology at the University of Calcutta, has first-hand experience of the Sabara Kols and other neighbouring tribes. The pamphlet contains a description of the customs and organisation of these natives, as well as an attempt at tracing the historical relationships of these aboriginals to the other inhabitants of mid-India.

### Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

### Ionisation in the Upper Atmosphere.

THE more important agencies which may conceivably cause the ionisation of the upper atmosphere of the earth are the ultra-violet light,  $\alpha$ - and  $\beta$ particles, all of solar origin, the penetrating radiation of cosmic origin, and the ionising radiations from terrestrial sources. The last mentioned may perhaps be ruled out immediately because of the fact that the conductivity of the lower atmospheric strata increases rapidly with the height for the first few kilometres. The possible effects of these ionising agencies have been considered in papers by Chapman and Milne, Benndoif, Elias, Lassen, and others. Recently, experi-ments with the electromagnetic waves of wireless telegraphy, together with theories of the propagation of these waves over the surface of the earth, have led to more definite information about the ionisation in the upper atmosphere, and it has been of interest to examine again the causes of the ionisation.

The experiments of Breit and Tuve with 70 metre waves, of Heising with 57 and 111 metre waves, of Wagner and Quack with 15 and 16 metre waves, and the experiments of Taylor on the skip distances of waves below 50 metres and the theoretical considerations of Taylor and Hulburt of these skip distances, show that the electron density N increases with the height Z above the earth, reaching a value of about  $4\times 10^5$ ; above the height where N has this value, nothing is known of the electron density except that it does not go on increasing. Although the wireless data are none too extensive, it may be taken that in summer (for the north temperate zone) the height where N is of the order 105 is roughly 150 km. at midday, rising to 300 km. at 2 A.M., and in winter is around 200 km. at midday and 600 km. at night. To this may be added an interpretation from the experiments of Appleton with 400 metre waves that N is of the order of 103 at about 100 km. for a June night in England.

Because of the diurnal variation in the ionisation, we chose the ultra-violet light of the sun as being the ionising agency deserving first consideration. In order to make an explicit calculation of the ionisation of the temperature, the pressure, and the constituent gases and their partial pressures, must be known at each height in the upper atmosphere. These we may take as given completely in the classical thermodynamic isothermal equilibrium theory of Humphreys, Jeans, and others. There is a question as to the existence of hydrogen in the upper atmosphere, but the conclusions given later are much the same whether hydrogen is there or not. There is also the question of ozone, or oxygen, which may be of great importance.

Further, the law of the recombination of the electrons with the positive ions must be known. When the electron collides with a positive ion, in order for recombination to occur, energy must be dissipated in some way, either (a) by a third body, such as another molecule—this is J. J. Thomson's theory of recombination, and complete formulæ are available—or (b) by radiation (simple formulæ for this case are easily derived). We must also recognise the possibility of the electron attaching itself to a neutral molecule, for when it does this, thereby producing a negative ion, it is no longer as energetic a refractor of the wire-

less rays. The oxygen molecule is the only important one in this connexion, and the values of the attachment coefficient measured in the laboratory for pressures of 10 mm. of mercury and above must be extrapolated to pressures below  $10^{-2}$  mm., perhaps a questionable extrapolation. Using all these things with (a) and making entirely acceptable assumptions as to the amount of ultra-violet light from the sun m the spectral region useful for ionisation, the N, Z curve rises rapidly from N=0 at Z=100 km. to  $N=4\times 10^5$  at Z=150 km; above this height N falls off slowly. With (b) the N, Z curve is much the same as with (a), but N falls off more rapidly with Z above 200 km. Either of these N, Z curves is main accord with the wireless data for full daylight conditions. One might be content with the agreement, for the present, were it not for what happens at night. At night, after the removal of the sun's ultra-violet radiations, the calculated N, Z curve sinks down somewhat towards the Z axis, but with no great change in the height at which N rises to  $4 \times 10^5$ . This is distinctly contrary to the indications of the nighttime wireless data, which require the electron bank to move up, so that the height at which  $N=4\times 10^5$  at midnight may be roughly twice the midday height.

In an endeavour to bring the calculations into accord with the wireless experiments, we may abandon the classical pressures, increasing them by a factor of  $10^2$  or  $10^3$  for heights above, say, 150 km, and at the same time increasing the partial pressure of the oxygen at these heights. In this way we can obtain the electronic densities at night and day required by the data of the shorter wireless waves. In increasing the classical pressures we are doing exactly what Lindemann was led to do in his theories of the meteors. He has suggested that the formation of ozone, with its attendant strong absorption from 2000 Å.U. to 3000 Å.U., may be a sufficient cause of temperatures and pressures higher than the classical ones. The existence of oxygen in the higher levels is supported to some extent by the recent identification of the auroral line with oxygen. There remains, however, a difficulty with the 400 metre waves of Appleton. A simple smooth increase of the total gas pressure and the partial oxygen pressure, which yields an ionisation satisfactory for the shorter waves, wipes out the night-time ionisation below Z = 130 km.

A way out is to assume an irregularity in the pressure-height curve; for example, to assume that the pressure drops off with the height, then increases to a maximum at 80 km. or 100 km., and decreases thereafter. Or, one may assume an ozone layer at this height and that the ozone does something peculiar to the ionisation, such as disintegrating slowly to oxygen during the night, thereby in some way maintaining the ionisation. Chapman has pointed out this possibility. Further, one may put aside hypotheses of the kind just mentioned and assume that the pressures of the constituent gases of the upper atmosphere are those of the classical calculation and that other agencies of ionisation exist besides the ultra-violet light, which are effective by night as well as by day. It seems that such a view meets with no immediate objections. For example, the number of a-particles from the sun necessary to produce the desired ionisation, if they are similar to those of radium-C, requires a small and quite permissible amount of radium at the solar surface. One can speak less definitely of  $\beta$ -particles of solar origin and of cosmic radiation. In a final summing up one may have to reckon with all of these possibilities.

E. O. HULBURT.

Naval Research Laboratory, Washington, D.C., June 16.

## The Total Reflection of X-rays.

As has been discovered by Compton, 1 X-rays falling on a polished surface at small glancing angles are totally—or at least nearly totally—reflected This phenomenon was explained by Compton as being due to the fact that the index of refraction of X-rays is a little less than unity:  $n=1-\delta$ , where  $\delta$  is small compared 2 with unity

Indeed, applying Fresnel's well-known expression for the intensity of reflection, we find in this case for

small glancing angles  $\phi$  the formula

$$\frac{I_{\tau}}{I_0} = \left| \frac{\sqrt{\phi^2 - 2\delta} - \phi}{\sqrt{\phi^2 - 2\delta} + \phi} \right|^2 \quad . \tag{1}$$

for the fraction of the incident energy which is reflected. A graph of this function (for  $2\delta = 6 \times 10^{-5}$ ) is given in Fig. I (curve A); it shows that below a certain critical angle  $\phi_0$ , given by  $\phi_0 = \sqrt{2\delta}$ , the reflection is total, whereas for angles  $> \phi_0$  the reflect-

ing power falls down rapidly

Since its discovery the phenomenon has been studied by several authors, but so far as I know it has not occurred to any one of them that this theory needs some extension in so far as the absorption has also a considerable influence on the reflection. According to elementary wave-theory we may take this into account 3 by putting in Fresnel's formula the complex value  $n = 1 - \delta + \epsilon i$  for the index of refraction, where 2ε is the absorption coefficient (for the energy) taken for  $1/2\pi$  times one wave-length. Instead of (1) we then get ·

$$\frac{I_{\tau}}{I_0} = \left| \frac{\sqrt{\varphi^2 - 2\delta + 2\epsilon \imath} - \phi}{\sqrt{\varphi^2 - 2\delta + 2\epsilon \imath} + \phi} \right|^2. \qquad (2)$$

This function is given in the curves B and C of

The values taken for the constants,  $2\delta = 6 \times 10^{-5}$ ,  $2\epsilon = 0.2 \div 10^{-5}$ , and  $1.5 \times 10^{-5}$  correspond to the reflection by iron of wave-lengths a little greater and a little smaller than 1740 X.U., this being the wave-length of the K-absorption discontinuity of iron.

I have performed some experiments showing the dependence of the reflection upon the absorption in a marked manner. The device used was a very simple one. Two identical rectangular mirrors of stamless steel were put together, their optically polished surfaces confronting each other. These surfaces were kept parallel and at a distance of 50µ apart from each other by putting small pieces of aluminium leaf between them at the four corners.

The 'slit' so formed was then put horizontally between the focal spot of an X-ray tube and the vertical slit of an X-ray spectrograph—the method being not unlike the 'method of crossed prisms

in optics.

Fig. 2 is a reproduction of a photograph obtained in this way (tungsten target; exposure 20 hours); it contains the spectral region on both sides of the K-absorption discontinuity of iron ( $\lambda = 1740 \text{ X U.}$ ).

If there were no such phenomenon as reflection against the steel plates, we should have obtained a spectrum of exceedingly short lines the height of which would be determined by the distance between the steel plates. Owing to the reflection against these plates the lines are much higher, their intensity

A. H. Compton, Phil Mag, 45, 1121; 1923
 W. Linnik and W. Laschkarew, Zeuschr f Phys. 38, 659; 1926.
 My attention was first directed to this point by Prof. Kramers
 The mirrors were supplied by Messrs Ottwav and Co., Ealing.

in vertical direction giving a measure of the reflecting power of the steel at the corresponding angle. complication is introduced by the fact that the radiation corresponding to relatively great angles is repeatedly reflected at the plates before leaving the recorded on the plate by the horizontal strice (these strice being due to megularities at the edge of the

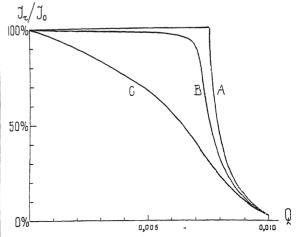


Fig. 1.—Theoretical curves for the reflecting power of non-tor X-rays as a function of the glancing angle  $\phi$  (in the figure Q stands for  $\phi$ ). A, when the absorption is neglected, B, with weak absorption (long wave-length side of K-absorption discontinuity), C, with strong absorption (short wave-length side)

plates). If we wish to compare the distribution of intensity in vertical direction with the theoretical curves B and C, this influence may be taken into account When this is done, the agreement between theory and experiment is sufficient, the limit of visible blackening corresponding to a little less than the angle for which, according to theory, the intensity should be reduced to half its mittal value.

So far we have considered only the influence of the wave-length on the reflection caused by a change of  $\epsilon$ (tormula (2)) The quantity o, however, also changes with the wave-length If we look apart from the neigh-



Fig. 2 —Photograph showing the reflecting power of non-tor  $\lambda$ -rays on both sides of the K-absorption discontinuity 1675 W LI, 1740 = Fe K-abs; 1753 = Fe  $K\beta_1$ .

bourhood of the absorption-edge, this should cause the 'critical angle' of reflection (in our experiment the height of the spectrum) to be proportional to the wave-length. This has been verified already by Compton, and is confirmed by my experiments (covermg spectral regions from 0 5 Å.U. to 2 Å U.), with considerable accuracy.

In the immediate neighbourhood 5 of the discontimusty, however, we should expect a decrease of

<sup>&</sup>lt;sup>5</sup> H. Kallmann and H. Mark, Ann. d. Phys., 82, 585; 1927.

the height of the spectrum, the late of this declease being particularly large quite near to the edge Whether such a phenomenon exists or not is a question which our experiments as yet are not able to settle; but it is hoped to get evidence on this point in the near future.<sup>6</sup>

In conclusion, I wish to thank Prof Coster and Prof. Kramers for the kind interest they have shown in this investigation.

J. A. Prins.

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#### A Sonic Interferometer for Liquids.

From thermodynamical considerations alone it should be possible to calculate the number of degrees of freedom, and consequently the association of molecules in the liquid state, if one could only determine the numerical difference between the specific heats at constant pressure and at constant volume. It is practically impossible, however, to obtain direct measurements of liquids at constant volume because of the elasticity of the walls of the containing vessel. But this difficulty can be obviated if the velocity of a compression wave in the liquid can be ascertained with sufficient precision, because the numerical difference between the specific heats can, by the aid of Newton's equation, be expressed as a function of the temperature, the coefficient of expansion, and the velocity of a compressional wave

With these thoughts in mind, and taking advantage of the work being conducted in this laboratory by R. W. Wood and A. L. Loomis on the physical and biological effects of high-frequency high-intensity-sound waves, we have constructed a sonic interferometer' capable of measuring the velocity of compressional waves in small quantities of liquids with an accuracy of one part in three thousand. This instrument is in many respects the sonic analogue of

the Perot-Fabry interferometer.

Corrections for the elasticity of the containing vessel can be entirely eliminated by using a sufficiently high frequency so that the wave-length is small in comparison with the diameter of the radiating source. We use, as a radiator, a piezo-electric crystal quartz disc 100 mm in diameter and 12 mm, thick carefully ground and polished plane parallel, which we cause to oscillate at frequencies from 200,000 to 400,000 cycles per second, producing waves from 3 to 8 mm. in length. The frequency of the oscillating circuit is determined with a precision wave meter. Contrary to the usual practice with piezo-electric crystals of allowing them to oscillate at their own natural frequencies, we have found that much more precise measurements can be obtained if the crystal is driven at certain frequencies well removed from the natural frequency of the crystal, for then the crystal resonance does not partially mask the exact moment when resonance is established in the liquid The small glass vessel containing the sample of liquid under investigation is placed on the oscillating crystal. When properly adjusted, the compressional waves pass upward through the plane parallel bottom of the vessel into the liquid and, because of the shortness of the waves compared with the dimensions of the vessel, pass upward in the liquid as strictly plane waves. They are then reflected from a plane surface immersed in the liquid and made parallel with the quartz disc. By carefully adjusting the distance of this surface

<sup>6</sup> From my photographs may be concluded that this effect is at any rate smaller than Kallmann and Mark's theory would lead us to expect.

with a fine micrometer screw standing waves can be produced. It is thus possible to measure 20 or more half wave-lengths with a precision of 1 100 mm. At each nodal point a small neon light loosely coupled to the circuit is extinguished, due to the reaction of the system of standing waves upon the crystal.

Characteristic results are presented in the accompanying table. These results are subject only to a revision of our wave meter calibration, and are of a self consistency one order higher than the number of places here presented. No variation in velocity with frequency can be detected within the frequency limits which we have employed, nor can any difference be detected when we vary the material and dimensions of the containing vessel.

VELOCITY OF SOUND WAVES IN LIQUIDS IN METRES/SEC

Material	Temperature			
	5°	15°	25°	35°
Distilled Water 1-0% NaCl sol 2-5% "" 5-0% "" Mercury Carbon Disulphide Chloroform	1439	1477 1487 1510 1540	1509 1520 1539 1569 1469	1534 1542 1561 1589 1468

The data published on the velocity of sound in liquids are for the most part in very poor agreement, and the methods employed, with the exception of direct determination in open water, involve serious corrections, the wave-lengths in general being large in comparison with the containing vessel. It is of interest to note that careful and laborious measurements have been made of the velocity of sound in the open sea by ascertaining the time of travel of a compressional wave for a distance of 53 nautical miles (E. A. Eckhardt, Phys Rev., 24, 452; 1924). The velocity thus obtained is 1492 metres/sec at 13° C. As a check we found at the same temperature a velocity of 1480 5 metres/sec for a 10 per cent. sodium chloride solution and 1503 metres/sec. for a 2 5 per cent. sodium chloride solution It is of interest to compare these results with that for distilled water from which substantially all the air has been removed, which at 13° C. we found to be 1470 metres/sec. The presence of small quantities of dissolved air materially affects the velocity

We are at present engaged upon a comprehensive study of water and of its solutions with several salts, and of a number of organic compounds and their mixtures, which we expect to publish shortly, together with a detailed description of the instrument.

JOHN C. HUBBARD. ALFRED L. LOOMIS.

The Tower, Tuxedo Park, New York.

#### The Flying Fox Pest in Australia.

The Council for Scientific and Industrial Research is finding difficulty in devising methods for coping with the large fruit-eating bats, commonly known as "flying foxes," which are a most serious menace to fruit growers in Queensland and New South Wales. There are five species in Australia, the commonest by far being *Pteropus poliocephalus*. Nocturnal in habit, and very gregarious, these animals live in large camps of hundreds of thousands of individuals. They migrate according to season and food supply, but

usually return to the same camps in successive seasons. In the daytime they cling to the branches of trees in dense numbers; they are restless and alert and a single gun-shot will put a whole camp to flight At night they depart in search of food such as fruit, berries, eucalyptus flowers, and honey. They are particularly fond of cultivated fruit, and the damage that they can do m an orchard in one night is appalling. The amount of fruit actually eaten is relatively small; the ground is strewn with fallen material which has been merely nibbled or claw-marked.

Many obvious methods of destruction have been Shooting is expensive Strychnine poisoning in the orchard is successful to an extent. Poison gases in the camps are not effective because of the timidity of the bat: it is almost impossible to give a lethal dose before they take wing. Infection with Bacillus typhi marium is said to have cleared Samoa of the pest some years ago, but we have failed to verify the report and it is understood that Samoa is still badly infested. A small 'flammenweifer' has been tried but, besides being dangerous and expensive, it is not suitable for general use

All these, and other, methods have been more or less successful in killing the creatures, but in every case the scale of possible operations is hopelessly inadequate. Wholesale slaughter must be achieved if the pest is to be minimised or even merely kept from increasing. Perhaps the most effective attack will be by biological means. Can any biologist suggest a sound line of investigation which the Council for Scientific and Industrial Research might follow?
A. C. D RIVETT.

Commonwealth Council for Scientific and Industrial Research, 314 Albert Street, East Melbourne.

#### Meteorology: Ancient and Modern.

I Do not disagree with those who hold that a review is not an appropriate subject of correspondence for the reviewed; but a paragraph by Mr. W. H. Dines in the issue of Nature for June 25, puts so compactly, as it were in a nutshell, a question of importance to a wider circle than that which is interested in the study of weather, that I may venture to ask for a little space in which to crack the nut and get at the kernel.

Mr. Dines writes (p. 917):

"The author prefers to measure radiative energy in a dynamical unit and states that he finds kilowatts per square dekametre the most convenient. The more usual unit is a gram calorie per square centimetre per minute, but something may be said in favour of gram calories per day, since a gram calorie is more generally understood than a joule and the day is the natural meteorological unit."

This raises the very important question of systematic units for the geophysical sciences. One of my reasons for preferring the kilowatt per square dekametre to the gram calorie per day is precisely that very few people understand what a gram calorie means, and the day that Mr. Dines refers to is not, in fact, a natural unit of time.

Like the questionist who could not define a parallelogram, though he would know one if he saw it, I could not myself say, off-hand, what exactly a gram calorie is for the purposes of computation. I venture to think it doubtful if Mr. Dines could, and would be prepared to risk a little upon the chance of not finding a single member present at a meeting of the Royal Meteorological Society, or (if I might whisper it) of the Royal Society itself, who could give, without reference to a book, an arithmetically workable reply to the question: What is a gram calorie? If any one

were fortunately so encyclopædic, the probable answer would be 41.8 million ergs.

I have also a deeper reason than that. The grand achievement of the first half of the nineteenth century was the discovery that heat had a dynamical equivalent and that energy is always conserved. From that principle we have learned that the energy of a hailstone in the clouds, of a lightning flash, and of a beam of sunshine, are all convertible one into another, perhaps through heat If, therefore, we really mean what we say in enunciating the principle of conservation of energy, it is urgently desirable that we should keep their identity always in view by expressing all in simple multiples of a single unit.

Now estimating the energy of a lightning flash in gram calories simply 'is not done' We naturally run to ergs for lightning, and if the lightning will not go to heat for its unit, heat might go to the lightning; and the more reasonably, since the heat unit only becomes a commensurable member of the family when

it also is expressed in ergs.

There is no such ambiguity or uncertainty about the kilowatt or the joule I go so far with Mr. Dines as to say that I am sorry that the names Watt and Joule, or any other name that does not explain itself, should have been attached to 107 ergs. I am sometimes exasperated by having to get down a book of reference to confirm or contradict my memory. A kilowatt-hour is an ugly unit, but it is what I, and many others, have to pay 7d. for, so I suppose even if I do not understand it and Mr. Dines does not, the Board of Trade as well as other consumers must think they do.

The word 'hour' leads me to the other lobe of the kernel, the day as a natural unit for meteorology. What, after all, is a day? In another part of his review Mr. Dines rallies me about a chapter on the Kalendar not being, strictly speaking, meteorology. Yet I am quite sure that without that chapter Mr. Dines and I would not understand each other as to what is meant by a day, and with that chapter to refer to I believe I should be able to convince Mr. Dines that by 'a day' he does not really mean a day but an arbitrary unit of clock time, 86,400 seconds, which is only a real day four times in a year.

These things are perhaps of little importance in the physics that is sheltered by a laboratory roof, and indeed the idiosyncrasics of things like calories and days may be transformed into scientiarum materia disciplinae puerilis etsi non scientiae ipsissimae; but for the open air study that aims at tracing the connexion between the hailstone, the lightning flash, the sun's radiation, and the strongth of the blizzard, equivalence and uniformity, if not everything, are at least the beginning and the end of everything; and there is no question that is of more vital importance to meteorology than a system of units with a common measure of energy as its foundation.

NAPIER SHAW.

June 29.

I po not wish to enter into a discussion upon the general subject of units with Sir Napier Shaw, although I believe that my opinion and his do not greatly differ, but I will explain why I profer gram calories per day to watts.

It seems to me that gram calories can be more easily explained to an ordinarily intelligent person than ergs, because the latter require some prior knowledge of dynamics before the explanation can be com-menced. Also the gram calorie lends itself very readily to the expression of the first result of radiation, namely, to changes of temperature; thus by easy mental arithmetic the thickness of ice that can be melted, or of water that can be evaporated, or the change in temperature of a given layer of air is readily calculated. Sir Napier's book is so interesting that it is likely that many people ignorant of dynamics will read it, and I think such readers have a claim to have the difficulties that arise from the inevitable use of technical terms reduced as much as possible.

I agree with what Sir Napier says about the principle of the conservation of energy, excepting that I do not see why it should be belittled by the use of a heat unit as well as a dynamical unit. We commonly use gallons and cubic feet without confusion according to which is the more convenient.

The day as a unit is open to objection, masmuch as there are three kind of days, polar, mean solar, and astronomical, but I think that if the term 'day' used without comment, few would suppose that it meant anything excepting a mean solar day.

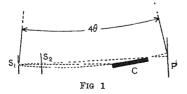
I must confess to having had to look up the definition of a gram calorie in a book of reference, I found three definitions, but they all give the same factor for converting gram calories into joules to the third significant figure, so that the ambiguity in the value of the unit is not at present such as to be of much importance in the measurement of radiation.

W. H. DINES.

#### The Reflection of Atomic Hydrogen from Ice Crystals.

DAVISSON and Germer (NATURE, April 16, p. 558) have shown that electrons are reflected from a nickel crystal in the directions which would be taken by X-rays of wave-length  $\lambda = h/mv$  if they were reflected from a slightly modified crystal lattice. This result, which is in accord with the ideas of L. de Broglie, indicates that the diffractive nature of the reflection is to be associated with the momentum rather than with the structure of the electron. One is therefore led to think that the same phenomenon may exist when atoms are reflected from a crystal surface. Although the investigation of this reflection is not yet completed, the preliminary results support this view and are therefore thought to be of sufficient interest for immediate publication

The experiment consists in finding the intensity of reflection in different directions when a narrow beam of hydrogen atoms strikes a surface of small ice crystals oriented at random. The geometrical arrangement of the collimating slits, reflecting surface, and the detecting plate is shown in Fig. 1. Atomic hydrogen



from a Wood tube is formed into a beam by the slits  $S_1$  and  $S_2$  in a manner similar to that used by Phipps and Taylor (Phys. Rev., 29, 309; 1927). The detecting plate P is also similar to that used by the same authors. The reflector C is a plane polished glass surface cooled by liquid air and covered with a thin coat of frost which, to prevent contamination, is continually renewed by the condensation of water vapour supplied by a suitably cooled side tube containing

The result of a typical exposure is represented by Fig. 2. The shading shows the relative intensities of the hydrogen beams. The lower dark line is the upper edge of the primary beam which passes above C without reflection. The other darkened portions, which are due to reflected atoms, exhibit the following principal features. There is an undarkened band at deflecting angles less than 6° followed by a relatively intense dark band between 6° and 12° which shades off into a uniform darkening at larger angles position of the intense reflected band is not affected by changing the inclination of C from 30' to  $3^{\circ}$  30', but there is a somewhat doubtful change in definition, the line appearing sharper with C set at the larger This point is not quite certain, however, angles. because of a possible illusion due to the difference in the

intensities of various plates. In this regard it is well to point out that if the surface C is placed tangentially to a circle passing through  $S_1$  of such a radius that an arc  $4\theta$ is included between  $S_1$  and P, all specular reflections from the individual crystal surfaces of glancing angle  $\theta$  will come to a focus on PIf the reflected band corresponds



FIG. 2.

to intense reflection at some critical angle between  $3^{\circ}$  and  $6^{\circ}$ , a sharper focus would be expected with C set at  $3^{\circ}$  30' than at any other smaller angle

Calculating the wave-length of the average hydrogen atom at the probable discharge tube temperature of  $400^{\circ}$  C., we find  $\lambda = h/mv = 0.98 \times 10^{-8}$  cm The exact structure of the ice crystal is not well known and still less certain is the nature of the reflection, for it seems reasonable that the surface structure of the crystal should play a more important part than in the reflection of X-rays. If we take 4 3 Å.U. (the probable edge of the unit cell of ice) as the distance between reflecting centres, a wave of the above length should be intensely reflected at a deflecting angle of about 12°, agreeing with the upper edge of the reflected band.

Although more accurate measurements are necessary to establish the exact nature of the phenomenon, it is now quite certain that some sort of a selective reflection is present at small angles. These measurements are being extended, together with an investigation of the effect of the discharge tube temperature on the position of the reflected band. It is also desirable to study the phenomenon with uni-velocity atoms, and it is thought that this may be possible.

THOMAS H. JOHNSON.

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#### Biological Fact and Theory.

WITHOUT the slightest hope of modifying or mollifying Dr. Charles Walker's opinions, yet may I point out to readers of NATURE that my previous letter (July 2. p. 12) was not intended to explain or defend in detail the chromosome theory of Mendelian inheritance, as that has been done more or less adequately in every recent text-book dealing with cytology or heredity. I merely directed attention to the fact that this theory is the only one in the field and that it is proving of great service in stimulating biological research. Its value to the student of practical breeding is acknowledged by Prof. Adametz in his "Lehrb. d. allgem. Tierzucht" in the following words: "Die zytologische Begründung der Mendelschen Vererbungstheorie erwies sich, wie im folgenden . . . kurz gezeigt werden soll, von ausserordentlich grossem Wert für das Verständnis verschiedener bis nun wenig verständlicher Vererbungsvorgänge." J. S. DUNKERLY.

#### Past Climates.1

By Dr. G C. Simpson, CB., FRS.

THERE is undoubted evidence that at some period or periods in the earth's history the climate in polar regions was much less severe than it is at present. In the Arctic there are indications of a climate when vegetation similar to that which is now found in subtropical regions flourished in Greenland and Spitsbergen. Geologists have generally supposed that during these periods the temperature over the whole earth was much more uniform than at present, so that the temperature difference between the equator and the poles was very small, if it existed at all These conditions are explained as the consequence of vast oceanic currents carrying warm water to polar regions The Gulf Stream Drift now maintains a mean annual temperature off the coast of Norway in latitude 70° N, which is 10° C. higher than the mean temperature of the latitude, and it is supposed that if its volume,

velocity, or both were increased, and other streams introduced, even higher temperatures could be maintained over the whole of the north polar This supposition is based on an entirely wrong conception of the physical causes which maintain

the existing climatic zones.

The primary cause of the difference of temperature between the equator and the poles is the shape of the earth, which results in higher latitudes receiving less solar energy per square kilometre of surface than lower latitudes. But the distribution of solar energy alone does not determine the temperature at the

surface; if it did the temperature near the poles would fall to near the absolute zero during the long polar winter. During the whole year, especially during the winter, the temperature in high latitudes is governed mainly by the heat conveyed from low to high latitudes by the general circulation of the atmosphere. On the other hand, the general circulation of the atmosphere is caused and maintained by the temperature gradient along the meridians. Reduce this temperature gradient and the general circulation decreases; increase it and the general circulation becomes more active. No one has yet estimated with any certainty the relative amount of heat transported by oceanic currents and by the atmosphere; but whatever the relative amounts, they both depend on the general circulation of the atmosphere, for the heat-carrying oceanic currents are all wind-driven surface currents. Thus, if we reduce the temperature difference between high and low latitudes, we reduce the amount of heat transported by both vehicles.

If a second Gulf Stream were introduced into the northern hemisphere by, say, cutting a wide channel

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across the middle of Asia similar to the Atlantic Ocean, heat would be carried into the polar basin, where the temperature would rise. But this rise in temperature would diminish the temperature difference between the equatorial and polar air on which the cyclones of the North Atlantic depend The winds associated with these cyclones are, however, the chief vehicle for transporting warm air into, and cold air out of, the polar basin; in addition they are the chief factors in driving the present Gulf Stream Drift along its path. Thus the opening of a new supply of heat to the polar region would be accompanied by a reduction of the old supply and the final result would be little or no change in temperature.

This reasoning is admittedly qualitative and alone would carry no great weight; but the existing temperature conditions are conclusive evidence of

TABLE I.—MEAN ANNUAL TEMPERATURES AT SEA-LEVEL

F - 4 - 4 - 3 -	Average Mean Annual Temperature				Percentage of Land		
Latitude.	North 2	South.	Difference.	Mean. 5	North 6	South 7	Difference 8
0 10 20 30 40 50 60 70 80 90 0-90	°C 26 2 26.7 25 3 20 4 14 1 5.8 - 11 - 10 7 - 18 1 - 22 7 15 2	°C 26 2 25 3 22 9 18·4 11 9 - 4·1 - 13 3	°C. 14 2.4 2.0 2.2 3.3 3.0 2.8	°C 26 2 26 0 24 1 19.4 13.0 5.6 -12 0 (-18.1) (-22.7)	% 22 24 31 43 45 58 61 53 20 0 39	% 22 20 24 20 4 2 0 71 100 100 17	% 4 7 23 41 56 31 - 18 - 180 - 100 22

its correctness. It would be difficult to imagine any distribution of land and sea more different, from the present point of view, than that which exists to-day in the two hemispheres. In the northern hemisphere the land and sea masses are arranged parallel to the meridians, and one ocean extends in an uninterrupted sweep from the equator to the pole; in the southern hemisphere the land and sea masses are arranged parallel to the circles of latitude. Two-thirds of the whole land of the earth is concentrated in the northern hemisphere, mainly about middle latitudes; while the southern hemisphere is mainly occupied by a great ocean which extends almost unbrokenly around the earth between latitudes 40° S. and 70° S In spite of these extremes of land and sea distribution the average mean annual temperature along every circle of latitude, as determined by Meinardus, is practically the same in the two hemispheres, as will be seen from Table I

Space does not allow of one examining this table in detail, but attention may be directed to latitude 70° as being representative of polar regions where one would expect any difference to be especially marked. Within the Arctic Circle there is a great sea; within the Antarctic Circle there is a great

 $<sup>^{1}\,\</sup>mathrm{Abridged}$  from a paper read before the Royal Meteorological Society on June 15.

continent. Outside the Arctic Circle the continents of North America and Asia form together the largest mass of land in any part of the earth; outside the Antarctic Circle a continuous ocean extends completely around the earth for many degrees of latitude. The Gulf Stream Drift, the greatest heat-carrying ocean current which exists, conveys warm water right into the heart of the Arctic Ocean; in the south no current carries warm water within 40° of the pole. Yet there is only a difference of 2° 8 C. between the average temperature along latitude 70° in the north and in the south. In the face of the evidence of Table I. there can be little doubt that the distribution of land and sea

the mean temperature off the coast of Norway being more than  $20^{\circ}$  C. higher than the mean temperature in the west of Siberia

In the zone between 40° N and 60° N, the temperature is highest over the east of the oceans and lowest over the east of the continents. This is due almost entirely to the fact that over the east of the oceans the prevailing winds have a southerly component and over the east of the continents a northerly component. This means that the chief transport of warm air from equatorial regions is over the east of the oceans, and as the winds control the movements of the surface waters the effect of the ocean currents is simply an addition to the

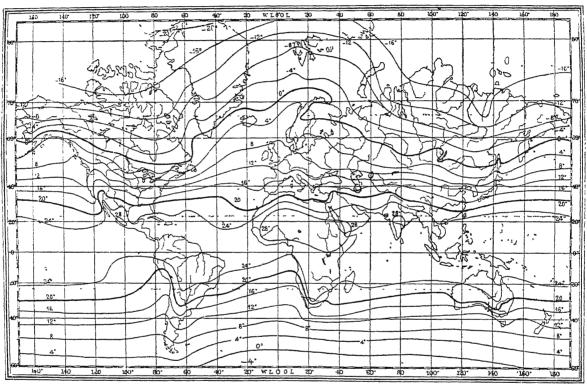


Fig 1 -Yearly isotherms.

plays little part in determining the average temperature along a circle of latitude and that no redistribution of land and water could possibly have raised the temperature in polar regions by the 25° C. required to give Spitsbergen the climate which exists to-day in the Mediterranean.

Although from the above discussion it would appear that the distribution of land and water plays a very small part in determining the average temperature of a zone, there is no doubt that it does play a very large part in determining the actual temperature in various parts of a zone.

Fig. 1 has been reproduced from Hann's "Lehrbuch der Meteorologie" to show the existing variations of mean annual temperature. We see at once that the temperature may be very different at different places along the same circle of latitude. The greatest differences occur along latitude 70° N.,

effect of the winds. On the other hand, the return flow of air from polar regions is mainly over the east of the continents, bringing with it low temperatures from higher latitudes. Whatever the distribution of land and sea within the zone we may expect the same effect, the transport of warm air will be over the east of the waters and the transport of cold air over the east of the land masses. The only question that arises is whether there are any limits to the difference of temperature that may be induced in this way. A glance at Fig. 1 will show that there appear to be such limits. The areas of the continents and of the oceans in the zone we are considering are very different, the extent of Asia being more than twice that of North America and the extent of the North Pacific Ocean being more than twice the extent of the North Atlantic. In spite of this difference of extent the lowest temperature on any latitude over North America is practically the same as the lowest temperature on the same latitudes over Asia. In the same way, in spite of the Gulf Stream Drift the highest temperatures over the North Pacific are very similar to those over the North Atlantic.

The figures are the most striking in the case of the low temperatures in the east of the continents. From latitude 40° N. to 60° N. the great Asiatic land mass produces the same lowering of the

TABLE II

Latitude	Lowest Mean Annual Temperature			Highest Mean Annual Temperature		
	America	Asıa	Difference	Atlantic	Pacific	Difference
°N 40 45 50 55 60	°C 10 6 1 - 5 - 8	°C 8 4 0 - 4 - 8	°C 2 2 1 -1 0	°C 17 14 12 9 8	°C 14 12 9 7 5	°C 3 2 3 2 3

temperature within one or two degrees as is produced by the much smaller North American continent. From this we may conclude that North America is already sufficiently extensive to produce the maximum cooling and that no readjustment of the land masses within this zone would produce lower mean annual temperatures than exist to-day

in the east of North America and in the east of Asia.

Similarly over the sea; when we find that the highest temperatures over the broad North Pacific Ocean are within three degrees of the corresponding temperatures in the narrow North Atlantic with its active Gulf Stream Drift, we may legitimately draw the conclusion that no redistribution of land and water would materially raise the temperature over the sea.

We thus see that in the north temperate zone there are quite definite maximum variations from the mean temperature of the circles of latitude, and that these exist to-day over both North America and Asia. The conclusion is irresistible that at no time in the past could mean annual temperatures exist locally in the north temperate zone which do not occur on the same latitude to-day.

Similar considerations applied to the polar and equatorial zones lead to the same conclusion, and there seems little doubt that

not only have there always existed climatic zones similar to those which exist to-day (assuming no change in solar radiation), but also at no time in the past is a limited region of the earth's surface likely to have had a higher or lower mean annual temperature than can be found somewhere on the same latitude in the northern hemisphere to-day.

## Historical Aspects of Disease.1

INFORMATION regarding disease in the past may be derived from three sources—from human and animal remains in ancient times (a considerably limited field), from a study of old sculptures, models, and pictures, which give more especially evidences of abnormalities in growth, and finally from a study of the medical and other writings of the past. Achondroplasia has been shown to exist in Egypt so early as the Sixth Dynasty (2900 B.C.), and achondroplasic dwarfs are often to be observed in Egyptian mural paintings. Pott's disease of the spine has also been noted in a bronze statuette of ancient Egypt. In a bust of Alexander the Great in his fatal illness, Sir Berkley Moynihan recognised evidences of cerebro-spinal fever. Achondroplasia and rickets are portrayed in the mural paintings of Pompeii and Herculaneum. The portrait of Ferdinand I., Emperor of Germany, painted in 1521 by Lucas van Leyden, shows the adenoid facies, although it was only in 1868 that Wilhelm Meyer of Copenhagen made adenoids known to the medical profession. Hystero-epilepsy has been identified in Raphael's pictures, and Charcot and Richer identified hysteria major and hystero-epilepsy in the engravings of the famous epidemic dancing mania which was prevalent in the Rhine provinces from the fourteenth to the sixteenth centuries Similarly, these authors figured a number of old

pictures showing plague victims with buboes, and among them Saint Roch, the patron saint of the disease.

Paintings may also show diseases which were much more common than at present (leprosy), or conditions which have disappeared from Great Britain as the result of efficient preventive legislation (hydrophobia). Although written records of acute disease are far more numerous than pictures and statues showing pathological conditions, their satisfactory interpretation is much more difficult owing to differences in the methods of description and nomenclature and the possibility of the existence of more than one disease raging at the same time, as was probably the case during the Antonine plague in Rome.

Now disease is not in itself a fixed entity, but the reaction of a complex organism to varying degrees of injurious influences, therefore a change in the organism or a change in the injurious factor may lead to widely different pictures Changes in the organisms responsible for infective disease occur with far greater rapidity than do changes in the higher mammals Some authors consider that changes in the former are much more important than changes in the host Wars and famine readily determine changes in the type of disease by setting up conditions favourable to the spread of disease and unfavourable to the victim of the epidemic spread. Such changes are most liable to occur in the acute diseases, but it is very difficult to decide whether a real change in type has occurred.

<sup>&</sup>lt;sup>1</sup> Abstract of the opening paper in the discussion on "Clinical Variation" in Disease from the Historical Point of View," delivered by Sir Humphry Rolleston to the History of Medicine Section of the British Medical Association at Edinburgh on July 22

Another factor which may alter the clinical picture is the presence of secondary infection, as, for example, was the case in the influenzal epidemic of 1918–19, where the presence of an additional hæmolytic streptococcal infection of the respiratory tract made the condition widely fatal, and so altered the influenzal picture that it was actually hinted in the lay press to be plague. Agam, it has been averred that the more severe type of smallpox was due to the same virus as present in mild smallpox complicated by a secondary streptococcal invasion favoured by insanitary conditions which so often prevailed in the past; but there have been very mild epidemics of smallpox in the past, and along with other evidence it would appear that the mild and severe form are variants of the same virus as is also cowpox. The presence of one disease may sensitise the organism to another infection, as, for example, the influence of measles in leading to tuberculosis.

Other diseases have shown definite changes in type, as in the case of scarlet fever, which forty or fifty years ago was often malignant and now is Other diseases appear to have altered, but in these cases this is often due to a separation out of the disease from a series of closely related conditions, as, for example, the separation out of typhoid, paratyphoid, and typhus from what was formerly known as continued fever It was only in 1675 that smallpox was first clearly distinguished from measles by Sydenham, although an eruption like smallpox was identified in an Egyptian mummy (1100 BC), and chickenpox was not definitely recognised as a distinct disease until 1767. War and its attendant circumstances may also give rise to new types of disease, as, for example, trench nephritis and trench fever, which were seen in North America seventy years before and not during the intervening years. After wars the epidemics and aberrant forms of disease that may have arisen tend to disappear.

The question as to when a disease first appears is one of the greatest difficulties, and may go back before the written records. Tuberculosis has been identified in the Egyptian mummies, and from the written records the pulmonary form was very prominent in Greece Mumps was also known in

ancient Greece. and the orchitic complication described by Hippocrates It may have been plague that attacked the Philistines after their capture of the Ark of the Covenant. Its history can, however, be most certainly traced in epidemic form from the great plague of Justinian which, arising in Egypt Add. 542, spread all over Europe There is good reason to believe that malaria was one of the factors bringing about the fall of ancient Greece and Rome, and the references in classical literature to this disease have been most carefully correlated by W. H. S. Jones His work shows the value of medical history in explaining that of the world

Although gout and rheumatism were only separated in the sixteenth century, chronic arthritis has been shown in neolithic skeletons and in ancient Egypt. Brettoneau separated diphtheria from other throat infections in 1821, although malignant sore throat was described by Aretæus in the second century A.D and by subsequent writers. Cerebro-spinal fever was first recognised in 1805. When encephalitis lethargica was first described in 1917, it appeared as if it were an entirely new disease, but scattered descriptions appear of conditions closely similar even so far back as 1413, when in Tournai there was an outbreak of epidemic hiccup which appears to be a manifestation of the myoclonic form of the disease. Appendicitis existed before it was described by Fitz of Boston in 1886, but it would appear to have become much more common in recent times, while chlorosis has for all practical purposes disappeared. Other anæmias would appear to have increased, or at least are more commonly recognised as a result of improved diagnostic methods.

Environmental factors also determine the incidence of disease, as in the case of parasitic diseases carried by animals or insect carriers, and then in the case of industrial diseases, diseases may have developed, reached a maximum, and then declined as the dangerous features were appreciated and controlled, as happened in the case of trinitrotoluene and tetrachlorethane poisoning. Finally, popliteal aneurism, which was very prominent in persons of a syphilitic taint in the days of horse-riding, has become relatively infrequent with the decline in

use of the horse.

### Obituary.

Prof. J. L. Gustav Tschermak.

PROF. J. L GUSTAV TSCHERMAK—Seysenegg, Hofrat, one of the most distinguished of modern mineralogists and petrologists, whose death was recently announced, was born at Littau, near Olmutz in Moravia, on April 19, 1836. He studied at the University of Vienna, and in 1857, while still a student, he accompanied Julius Schmidt in his examination of the extinct volcanoes of Moravia, and was responsible for much of the field work as well as for the subsequent determination and description of the specimens obtained. In 1858 he published his first paper, which dealt with the trachytes in the neighbourhood of Banov in Moravia. This was the earliest of a long succession

of important publications spread over more than sixty years. In 1861 he was received into the Faculty of Science of the University and acquired the right to give academical lectures. In 1862 he was appointed custodian to the Court collection of minerals.

From 1863 until 1866 Tschermak travelled in the Alps and Carpathians, and as a result published in 1869 a treatise on the porphyritic rocks of the "Middle Geological Epoch" (actually from the Carboniferous to the Cretaceous) in Austria. For this he received an award from the Vienna Academy of Sciences. In 1868 he was appointed Director of the Court collection of minerals, and at the same time was nominated professor of mineralogy and

petrology at the University He retained this post until his retirement in 1906 as emeritus professor and emeritus director of the Mineralogical and Petrological Institute of the University. He was then ennobled as Tschermak von Seysenegg In 1875 he was made a full member of the Vienna Academy of Sciences He was also honorary member of the scientific academies of Berlin, Gottingen, Munich. Paris, Rome, Leningrad and Sweden. He was foreign member of the Mineralogical Society and of the Geological Society of London

The first edition of Tschermak's treatise on mineralogy was published in 1881 and the sixth in 1905. In 1871 he established the Mineralogische Mitteilungen, which formed for a time a portion of the Jahrbuch der Kaiserlich-Koniglich geologischen Reichsanstalt. In 1878 it became the Mineralogische und petrographische Mitteilungen (familiarly known as Tschermak's Mitteilungen), which still continues.

Tschermak's most important work was on the constitution of the silicates. So early as 1865 he published a paper on the felspar group, a synopsis of which appeared in the Geological Magazine for the same year. In this he showed that the plagioclase felspars are built up of varying proportions of albite and anorthite, minerals which closely resemble each other in their crystalline form and in their molecular volumes. This formed the starting-point of Becke's work on the same subject. Tschermak afterwards applied similar principles to the

amphiboles, the pyroxenes, the micas, the scapolites, the chlorites, and the tourmalines, as well as to the rhombohedral carbonates. He also claimed that he could obtain definite silicic acids by treatment of silicates with acid solutions, but this contention has not been universally accepted. He gave considerable time to the study of meteorites, of which a fine collection is housed in the museum at Vienna

Tschermak married Fraulein Hermine Fenzl, who survives him. His two sons hold professorships, at Vienna and Prague respectively.

WE regret to announce the following deaths

Sir William Ashley, emeritus professor of commerce in the University of Birmingham and president in 1907 and 1924 of Section F (Economics) of the British Association, on July 23, aged sixty-seven years.

Sir Bryan Donkin, honorary member of the Royal Medico-Psychological Association, and author of many publications on criminology and related subjects, on July 26, aged eighty-two years.

July 26, aged eighty-two years.
Sir Harry Johnston, G.C M.G., K.C.B.,—zoologist, ethnologist, and explorer—distinguished particularly by his scientific contribution to knowledge of tropical

Africa, on July 31, aged sixty-nine years.

Dr. Paul Kessler, professor extraordinarius of geology at the University of Tubingen, and author of several interesting papers on the morphology of fossil Ammonoidea, on July 14.

Mr. E. Sanger-Shepherd, well known for his work on colour photography and the development of instruments for photographic sensitometry, on July 8, aged fifty-eight years.

#### News and Views.

All large passenger ships have a complete staff of radio operators and keep a continuous watch for radio signals. The great majority of ships, however, have only one radio operator, and so a continuous watch is impossible. Such a ship might be in close proximity to a ship needing assistance and hear nothing of its distress calls. Probably a much larger ship at a greater distance away would be diverted from its course to give the requisite assistance. This would lead to delay and greatly increase the cost. This difficulty has now been overcome by the apparatus designed by the Marconi International Marine Communication Co., Ltd. The object of this auto-alarm is to ensure that the call shall be received by the smaller ships even when the operator is off duty. The alarm signal consists of a series of three dashes, each of four seconds duration, separated by intervals of one second. The Post Office regulations insist that this signal, the forerunner of the distress (S.O.S.) call, shall operate the receiving apparatus, which rings a bell to recall the operator, even when it is sent by hand with the aid of an ordinary watch with a seconds hand. If the signal be wrongly sent, even although the apparatus is set in motion, it will instantly come back to zero and be ready to receive signals correctly sent. Allowances are made for want of skill of the operator by making it operate when the dashes have intervals between three and five seconds long and the blanks have intervals lying between one

fifth and two seconds. The apparatus operates even when two ships are sending Morse messages at the same time and on the same wave-length. When a distress call is received, alarm bells are rung on the bridge, in the radio cabin, and in the operators' sleeping quarters.

SIR RONALD Ross, director-in-chief of the Ross Institute and Hospital for Tropical Diseases, Putney Heath, S.W., has been awarded the gold medal of the African Society in recognition of his valuable work and its services to Africa. In the report of the Ross Institute and Hospital for 1926, recently received, reference is made to the need for extension of the hospital and especially to the importance of the extension of malaria control operations connexion attention is directed to the British Mosquito Control Institute at Hayling Island, and it is suggested that when young men are engaged for service on plantations in the East, it might be advantageous if they could spend a few hours or days at Hayling Island to obtain an idea of the habits of mosquitoes and the methods of control. Sir Ronald Ross was invited by the Indian Tea Association to visit plantations in India and to inspect the work being done there to reduce malaria. He visited also Malaya and Burma, and has prepared a report on his observations. Comparing his experiences while on service in India from 1881-1899 with his recent observations in Ceylon, Malaya, Assam, and Calcutta. he concludes there must be a marked reduction of culicime mosquitoes in the houses of Europeans, due principally to better knowledge of these insects and of their breeding habits, and also to the activities of public health departments. He advocates still further control of both culicimes and anophelines by public action.

MALARIA control in Malaya has reached a high state of efficiency and will quite possibly succeed in practically banishing the disease or at least in reducing the pandemic to small local outbreaks. In Burma, Sir Ronald found that advance has not been nearly so rapid, apparently due chiefly to the fact that the planting community is not nearly so large and there is much more popular, and therefore less instructed, control of the administration. Assam presents a state of transition, the details of malaria control for a large number of estates have been worked out, but the whole movement should be unified in order to prevent expensive local failures due to recalcitrant neighbours and other causes. Calcutta has still much to learn from Singapore; it does not spend enough on mosquito control. Dengue is prevalent every year and malaria still haunts the outskirts of the city The housing of the poorest classes is bad, and Sır Ronald makes an appeal for its improvement by legislation and action. He refers to the formation of anti-malaria and public health societies in Bengal, managed by the people themselves, with many branches in remote villages and rural areas. In conclusion, he remarks that what can be done in other countries against malaria can be done in all. "Is it not time to hope that malaria control by modern methods will soon be adopted everywhere ?"

FURTHER information is now available relating to the remarkable find of a liquid in the canopic jar of Queen Hetepheres, mother of Khufu, which unquestionably has been preserved since the Pyramid age. An analysis has been made by Mr. Lucas, chemist to the Egyptian Antiquities Department, of which some particulars are given in the Times of July 26. It appears that the liquid is a 3 per cent. solution of natron, of which the water has been stained yellow by the organic contents of the canopic jar. It is suggested that the water has been preserved owing to the fact that it was enclosed in an alabaster box with a tight-fitting lid and buried in a chamber cut from the living rock at a depth of 100 ft. and in a niche which had been built up with plaster-covered limestone slabs.

SINCE the resumption of archæological excavation after the War few fields have advanced more rapidly in public interest than Mesopotamia, which at one time was regarded almost exclusively as the province of the specialist. This is to be attributed to a great extent to the broader treatment which has been given to the announcements in the press of the results obtained both by the Weld Blundell Oxford University and Field Museum expedition at Kish and the joint expedition of the British Museum and

the Pennsylvania University Museum at Ur further and welcome indication of this trend is afforded by the publication of a guide to the antiquities of Mesopotamia by Mrs MacKay It deals with sites dating from the earliest period down to, but not including, the Islamic period. For the convenience of travellers the sites are grouped under the stations of the railway from which they are most accessible, and each is described briefly but in sufficient detail to enable the non-expert to grasp the essential significance of what has been revealed by excavation. Brief historical notes, a chronological table from the "Cambridge Ancient History," and a few useful hints on equipment are included. The guide is issued by K. Mackenzie, the Book Shop, Baghdad, Iraq.

FURTHER particulars are announced of the seventeenth International Congress of Orientalists to be held at Oxford from Aug 27-Sept 1, 1928. The president of the Congress will be the Right Hon. Lord Chalmers, and Prof. F. W. Thomas, Boden professor of Sanskrit, will act as chairman of the organising committee. The meetings will be held in the Indian Institute and adjoining College and University buildings. The work of the Congress will be distributed among nine sections, of which one will be general, including anthropology, ethnography, prehistoric archæology, comparative mythology, and folklore. Other sections will be: Assyriology and cognate subjects, Egypt and Africa, Central and Northern Asia, the Far East, India and Iran, including the Indo-European languages of Asia, the Old Testament, the language, literature, etc., of Islam. and oriental art. Each section will have its sectional president. The languages of the Congress will be French, German, and English; but other languages may be used with the permission of the sectional president. The fee for the Congress is £1. Applications for membership should be addressed to the treasurer of the Congress, Mr. G. R. Driver, Magdalen College, Oxford. Titles of papers offered should reach the secretary, Mr. C. N. Seddon, not later than Mar. 1, 1928.

An active eruption of Vesuvius began towards the end of July, and on Aug. I there was a new flow of lava and an increase in the number and intensity of explosions inside the volcano. A large amount of material has been ejected in the form of volcance bombs and ash.

A BRIEF report on the great Kansu earthquake of May 23 (May 22, G.M.T.) has come from Mgr. Buddenbrock, Vicar Apostolic in Kansu (Times, July 30). The writer, who was at Lanchow, the capital of the province, at the time, states that the city of Kulang has disappeared, and he estimates that 100,000 people were killed. Kulang is about 120 miles north-west of Lanchow, and between the positions assigned from seismographic evidence to the epicentre, and nearer to that given by Prof. Turner (see NATURE, vol. 119, pp. 826, 937). According to information received by

the China Inland Mission in London, the earthquake was strong enough to damage buildings so far as Liangehowfu, 150 miles north of Lanchow.

The third meeting of the International Union of Geodesy and Geophysics will be held at Prague on September 3-10. Papers will be read and discussions will take place in the various sections of the Union, namely, geodesy, seismology, meteorology, terrestrial magnetism and electricity, oceanography, volcanology, and hydrology.

DR. EDWARD R. WEIDLEIN, director of Mellon Institute of Industrial Research of the University of Pittsburgh and president of the American Institute of Chemical Engineers, will spend the months of September and October in visits to European educational institutions, research laboratories, and chemical works. While abroad he will also confer with a number of educationists and laboratory directors regarding various problems in industrial research organisation and management. Dr. Weidlein expects to be in England during the period Sept. 14-24, where he may be addressed c/o The Old Colony Club, 79 Fore Street, London. His continental trip through Germany, Switzerland, Italy, and France will follow.

THE ninth International Congress of Zoology will meet at Budapest from Sept. 4-9, under the presidency of Dr. G. Horvath. The offices and the general meetings will be in the Hungarian National Museum, and the sectional meetings will be in the University Institutes of Natural Science and Medicine. A large number of communications have already been offered. In addition to the more serious business, opportunity will be given for excursions on the Danube, to mountains in the neighbourhood, to Lake Balaton, and to the Puszta Hortobágy, with its herds of horses, cattle, and sheep. Various facilities are given by the Government and railways of Hungary. Owing to an unfortunate statement in the preliminary announcement, notices appeared in German zoological publications which made one fear that the Congress would lose its international character; but we understand that any difficulties there may have been are now entirely smoothed away, and a successful gathering, the first since Monaco in 1913, seems assured.

THE fourth Conference of A.S.L.I.B. (the Association of Special Libraries and Information Bureaux) will be held at Trinity College, Cambridge, on Sept. 23-26. The proceedings will open with a reception by Sir J. J. Thomson in the Fellows' Garden of Trinity, and discussions will occupy the mornings and evenings of succeeding days. The subjects for discussion include the following: the Report of the Public Libraries Committee of the Board of Education (Mr. A. E. Twentyman and Lieut.-Colonel L. Newcombe); recent developments in connexion with the Science Library, South Kensington (Sir Henry Lyons); information, organisation, and statistics in industry (Major L. Urwick, Mr. S. J. Nightingale, Mr. Hugh Quigley, Mr. W. Wallace, Mr. A. E. Overton, Mr. F. W. Tattersall); patent classification (Mr. A. R. Wright, Mr. Allan Gomme), problems of the information bureau (Mr A F Ridley, Mr. P. K. Turner, Dr. J C. Withers), photographic reproduction of printed and MS. material (Mr N. Parley, Sir William Schooling, Mr. R H. New); standards of book selection in science and technology (Sir Richard Gregory). Further particulars of the Conference can be obtained from the Secretary, ASLIB., 38 Bloomsbury Square, London, WC1

THE Pacific Hydrobiological Station at Vladivostok was established in 1925 with the view mainly of research on the conditions of the Russian fisheries in the Pacific, but it is working not only on the problems of immediate practical interest, but also on various hydrobiological questions (Priroda, 1927, No. 3). The station is situated at the Basargin Peninsula, about 6 kilometres from Vladivostok, where some old military buildings were converted into laboratories and houses for the staff. During the first year of the existence of the station a systematic study of the marine fauna was begun and regular hydrological observations organised. The fauna of this part of the Pacific proved to be extremely rich, including numerous species of fish not previously known from Russian waters, while the invertebrate fauna is also of unusual interest. Apart from this purely scientific work, a detailed investigation of fisheries in the Bay of Peter the Great and at the Kamtchatka shores was organised. This study revealed that Russian fishing in the Pacific waters is almost exclusively devoted to salmon, while a number of other valuable fish are not exploited only for lack of information as to their valueand methods of fishing. Laboratory accommodation at the Station is calculated not only to permit scientific work of its own staff, but also to enable outside students to work there temporarily.

THE seventh annual report of the Industrial Fatigue Research Board gives an account of its constitution. investigations, and researches. Its work roughly falls into three main categories: (1) Investigations of particular problems of wide industrial importance, such as hours of labour, accident causation, design of machinery, ventilation, rate of improvement in industrial occupations, vocational guidance, the relation of school-leaving age to well-being and proficiency. (2) Studies of specific problems submitted by government departments and industrial associations, e.g. sickness in cotton-weaving sheds and in the printing industry, weight carrying by men and women, telegraphists' cramp, vision and lighting, vocational selection. (3) Experimental researches undertaken in university and other laboratories, e.g. principles governing muscular energy, acquisition of skill, psycho-galvanic reflex. The Board directs attention to the necessity for a more general realisation of the possibilities and necessity for such research which, while its immediate effects may be less striking than those resulting from technical and mechanical developments, yet has far-reaching effects valuable both to the worker and employer. For example, an alteration in some material condition may lead to an increased

output immediately: if, however, that alteration should put too much strain on the workers, then increased sick-leave or general dissatisfaction may result, the effects of which will only be gradually felt. The Board suggests that small committees representing employers and workmen should be set up in the more important industries for the purpose of discussing and submitting for investigation problems affecting the human factor in industry

In the May issue of the journal of the Allgemeine Elektrizitats Gesellschaft an account is given of a lecture by Dr. Lubowsky on the transport and packing of engineering products for foreign markets. This subject is of the greatest importance to industry and deserves close study. At the beginning of the War, the Germans made many tests, using suitable machinery, to find out the stresses called into play by every conceivable method of packing, the amount of packing material required, and the space taken. It is sometimes specified that the apparatus ordered should be contained in a soldered sheet tin case without stipulating on the methods requisite for the adjustment between the external and internal atmosphere. These are essential on account of the variations of temperature and atmospheric pressure A small accident to a soldered edge often leads to the collection of condensed water in the box. This may arise also from the hygroscopic nature of the goods. Drying chemicals will not prevent the bad effects produced by condensation. The A E.G. have found that hard wood cases suitably dove-tailed and utilising pitch-paper and oil-cloth are cheaper and much more serviceable. When there is a risk of breakage the goods are suspended by spiral springs during transport. In order to ascertain their weakest points, cases and casks were periodically allowed to fall to the ground from given heights. Thus particulars have been obtained for nearly every class of wood as to the requisite thickness, best method of stiffening, number, strength, and distance apart of the bands, best length and finish of the nails, appropriate humidity, and many other useful data.

WE referred incidentally in a recent issue to the educational experiment being made at the Malting House School at Cambridge, which aims at stimulating and developing the 'finding-out' interest in children from the age of 4-5 years onwards. A film privately exhibited by the school a week or so ago in London illustrated the methods used. The children, mostly between four and seven years of age, were shown finding out for themselves the properties of things. the sequences of various processes, the relations between objects, and between their own activities and these objects. They were shown trying whether leaves would burn, whether metals would melt, or how much water would put the fire out; a see-saw led them to try to weigh one another, and then to weigh and compare various objects on a balance, the water-tap in their sandpit went out of order and one of them tried with a spanner to turn it; some of them modelled in clay or used a potter's wheel; others listened to a gramophone, managed by them-

selves; they were shown taking care of their live pet animals, and dissecting ('looking inside") dead ones, they handled well and truly hammer, nails, chisel, a large saw, a drilling machine, a lathe; they sewed and wove; and moving freely in and out of these and other interests, they enjoyed, not less but not more, imitation and phantasy games, running about and climbing, like any other lively children of their ages. As one watched the ease and independence with which the children went about their manifold activities, it could scarcely be doubted that whatever additional methods practical educational needs might impose, all that children learned by this method is so much clear and certain gain.

THE Bureau of Standards at Washington publish a directory of commercial testing and college research laboratories. Apparently there are 207 commercial testing laboratories throughout the United States and no less than 143 college research laboratories. These form a most useful adjunct to the National Bureau of Standards, the main object of which is to make tests and carry out investigations for other government departments. The other laboratories do the ordinary routine work, and so the Bureau has more time to devote to research and official work. In Great Britain, engineers have standard specifications which they are continually revising, but the number of institutions which are prepared to test whether the material or workmanship comes up to the standard is very small and is practically unknown to many purchasers, and hence they hesitate to buy on specifications and trust too much to a firm's reputation. The Bureau of Standards has inaugurated a 'certification plan.' On this plan, lists of manufacturers are compiled who are willing to supply material in accordance with certain specifications and to guarantee that they fulfil the required conditions. We know of certain clauses in several widely used specifications which are virtually a dead letter in England, because very few purchasers know where they can get the required tests made, and even when they do, the prices are found to be prohibitive. In the immediate future there will probably be a great increase in the demand for such tests both in connexion with our domestic and our export trade. In our opinion a directory similar to the one produced by the Bureau of Standards in America, giving a list of both commercial testing and college research laboratories, would be a boon to industry in Great Britain.

The following awards for the year 1927–28 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Company: Fellowships renewed: Mr. R. M. Deanesly, University of Oxford, at the Ramsay Department of Chemical Engineering, University College, London (Fellow, 1926-27); Mr. H. B. Spalding, University of Oxford, at the Massachusetts Institute of Technology (Fellow, 1926-27). Fellowships awarded: Mr. C. G. Akhurst, Imperial College of Science and Technology, London; Mr. A. Caress, University of Cambridge; Mr. I. G. Nixon, University of Cambridge; Mr. D. R. Pryde,

University College, Bangor, Mr. J. Muir Smith. Armstrong College, Newcastle, Mr. F. Witt, Imperial College of Science and Technology, London. The Salters' Institute has also awarded fifty Grants-in-Aid to young men employed in chemical works to facilitate their further studies.

THE Japanese meteorological observatory at Zinsen, Tyosen (Korea), has just issued a very comprehensive report of its activities during the year 1923. Hourly values are given of air pressure and temperature, relative humidity, and wind speed and direction, at the central observatory, while four-hourly observations of various meteorological elements at the observatory and its branch stations, which are numerous, are summarised. Details of the seismic and (absolute) magnetic observations made at Husan and Zinsen are also included. The work appears to be well organised, and the report is detailed and satisfactorily produced. The letterpress is given in Japanese characters and also in English. The customary European symbols for cloud forms and other meteorological phenomena are replaced by picturesque Japanese symbols, which by no means convey their import to a European reader at a glance.

REFERRING to the review which appeared in NATURE of July 16, p. 76, of Gurwitsch's "The Scientific Principles of Petroleum Technology," Prof. B. N Menschutkin, of the Polytechnic Institute, Leningrad, writes pointing out that Prof. Leo Gurwitsch died on May 30, 1926.

The National Research Council, Washington, D.C., has issued through its Committee on Child Development a "Directory of Research in Child Development" (Reprint and Circular Series, No. 76, Price 50 cents). The entries, 425 in number, give the names of research workers in the United States and Canada, the subjects of their specialties, and the research problems upon which they are engaged.

WE have received from Mr. C. Baker, 244 High Holborn, W.C.1, and Messrs. Ogilvy and Co., 20 Mortimer St., W.1, their respective catalogues of second-hand and shop-soiled scientific apparatus for sale at reduced prices. Prospective purchasers would do well to consult these catalogues in the first place, for many bargams in microscopical and other apparatus, cameras, etc., are listed.

Messes. Flatters and Garnet, Ltd., 309 Oxford Road, Manchester, have sent us their catalogue of microscopical preparations (Catalogue A, 1927). They claim to be the largest actual mounters of microscopical preparations in England, and their normal stock of mounted slides numbers 25,000-30,000. The list is a very complete one and comprises preparations illustrating all the biological sciences as well as petrology and metallurgy.

THE Edinburgh Mathematical Society has begun to issue a new series of its Proceedings. An attractive opening part contains ten research papers, Profs. Baker and Turnbull and Mr. Richmond being among the contributors. A general reader will find most interest in Prof Gibson's "Sketch of the History of Mathematics in Scotland to the End of the Eighteenth Century." This paper gives an account of the mathematics studied in Scottish universities in their early days, and refers especially to the work of Napier and of James and David Gregory. It is unfortunate that a standard size of page has not been adopted for the new venture, also that the pages are not numbered in the customary place.

The British Museum (Natural History) has added four sets of picture post cards to the two issued last year illustrating native British orchids. The various species are beautifully and faithfully done in colours, and the price of each set (F 16 to F 21) is one shilling, each consisting of five cards with an explanatory leaflet. Thirty out of some fifty known British species are represented in the six sets so far published. Many of them are uncommon, and some very rare and in danger of extinction. One aim of the Natural History Museum postcards of British flowering plants is to protect rare species by indicating the fact of their rarity and by providing a ready means by which unknown plants may be identified without picking them.

The Proceedings of the South London Entomological and Natural History Society for 1926-27 forms an attractive booklet of more than 150 pages with several half-tone plates. It contains a number of short papers which should appeal more especially to Thus Mr K. G. Blair discusses entomologists. stridulation in various orders of insects, while Dr. E. A. Cockayne writes on intersexes in Lycanida, and Mr. R. Adkın has a suggestive article on the possibility of new species being in the making in the case of certain British moths. The reports of the meetings of the Society indicate that its members take a live interest in various branches of natural history and botany, and the exhibits recorded cover a wide range in those subjects.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :- A fulltime lecturer in mining science and allied subjects under the director of education, Merthyr Tydfil, for the instruction of students in the higher stages of the joint scheme of education adopted by the L.E.A.'s in the South Wales and Monmouthshire coalfields-The Director of Education, Town Hall, Merthyr Tydfil (Aug. 9). A secretary for education for the Borough of Widnes-The Town Clerk, Town Hall, Widnes (Aug. 15). A highly qualified assistant at the East Malling Research Station, to abstract reports of a scientific nature—The Secretary, East Malling Research Station, East Malling, Kent (Aug. 15). A bacteriologist for the Dairy Research Laboratories, New Zealand - The High Commissioner for New Zealand, 415 Strand, W.C.2 (Aug. 23). An assistant lecturer in zoology in the University of Birmingham-The Secretary, University, Birmingham (Aug. 24). A junior assistant in chemistry in the agricultural department of the Marischal College, Aberdeen-The

Secretary, North of Scotland College of Agriculture. 41½ Umon Street, Aberdeen (Aug. 27). A professor of zoology in the University of Manitoba—The Registrar, University of Manitoba, Winnipeg, Manitoba, Canada (Sept. 1). An assistant lecturer in botany and zoology at the University College of Swansea-The Registrar, University College of Swansea, Singleton Park, Swansea (Sept. 5) An assistant lecturer in electrical engineering at the Manchester Municipal College of Technology—The Registrar, College of Technology. Manchester (Sept. 19). Two lecturers, in biology and chemistry respectively, in the University of Western Australia—The Agent-General for Western Australia, 115 Strand, WC2 (Oct. 1) A head of the department of building of the Manchester Municipal College of Technology—The Registrar,

College of Technology, Manchester (Oct 3) senior demonstrator in the department of physiology of the University of Otago, Dunedin, New Zealand -The Registrai. University of Otago Dunedin. New Zealand (Oct 20) An assistant in the department of physiology and brochemistry of University College. London-The Secretary, University College, Gower Street, W.C.1 A temporary assistant bacteriologist for research on fabrics in Admiralty Establishment-The Secretary of the Admiralty (CE. Branch), Whitehall, S.W.1 An agricultural botanist at the Seale-Hayne Agricultural College-The Principal, Seale-Hayne Agricultural College, Newton Abbot, Devon. A laboratory assistant in the zoological laboratory of the University of St. Andrews-Prof. D'Arcy W. Thompson, The University, St. Andrews.

#### Our Astronomical Column.

NAKED-EYE SUNSPOTS.—A large circular or 'regular' spot has recently been in transit across the sun's disc. This is the second appearance of the spot which began its existence more than a month ago in the previous 10tation. Its area measured on July 25 was a little more than 500 millionths of the sun's hemisphere, which is about the limit at which spots become nakedeve objects to keen evesight. Owing probably to its regular outline, the spot was seen without difficulty by several observers Particulars of its position are given in the table below, including another spot, No 6, which was on the disc about a month ago. This spot was seen on one or two days only, partly on account of unfavourable weather, but as its area exceeded that of the more recent spot, it has also been tabulated Spot No. 6 represents the third and last appearance of a naked-eye group whose earlier history is given in Nature, May 21, p 759, and June 18, p. 903.

Central Meridian Latitude Passage. No. Date on Disc. Area. July 5.4 July 27.8 June 29-July 11 15° N 1/1500 s° ŝ 1/1900 July 21-Aug. 3

SPECTROSCOPIC PARALLAXES OF EARLY TYPE STARS. The spectroscopic method of determining parallaxes was at first confined to stars of later type. It is considerably more difficult to apply it to types A and B, and it is necessary to use sharpness of spectral lines as a criterion, and further to employ different standards of sharpness for each subdivision of spectral type. Two papers describing researches on this subject made at the Norman Lockyer Observatory appeared in *Monthly Notices of Royal Astronomical Society* for March. The first, by D. L. Edwards, applies various tests to the method of Adams and Joy and gives curves connecting the line-character with absolute magnitude for types  $B_0$  to  $B_9$ . These curves are then used to deduce parallaxes for 300 stars. The resulting parallaxes are compared with those by other authorities and found to be somewhat smaller, the

mean difference being about 0 002".

The stars of type  $A_0$  to  $A_5$  are dealt with in a paper by Dr. H. C. Woods.

The classification is chiefly by the sharpness of the hydrogen lines, and is tested by trigonometrical and group-motion parallaxes. This list also contains 300 stars. The deviations in individual stars from the trigonometrical or groupmotion values are considerable in stars with peculiar spectra, but generally small for the others.

The stars in both lists are naked-eye stars contained

ın Boss's P.G.C.

VARIABLE ROTATION OF THE EARTH —Prof. W. de Sitter investigates the fluctuations in the motion of the sun, moon, Mercury, and Venus in Bull. Ast. Int. Netherlands, vol 4, No 124. He adopts from ancient observations the secular acceleration  $+\,1''\,\,80$  for the sun and +5'' 22 for the moon, noting that the ratio of the former to the latter is too high according to the ordinary theory. He finds that the accelerations of the sun, Mercury, and Venus are proportional to their mean motions, as they should be if produced by tidal friction. the moon alone is discordant. He suggests that the secular acceleration of the moon may itself be variable. Taylor and Jeffreys found that the friction occurs almost entirely in shallow seas, where they would be liable to slow changes owing to silting up, etc. Accordingly, the acceleration in modern times (which is the one determined for the planets and partially for the sun) may be different from that determined for the moon, which depends on ancient observations. The changes in the earth's rotation are concluded to be of two kinds: one due to tidal friction, supposed to be variable, the other due to changes in the earth's moment of inertia.

Prof. de Sitter thinks it better to treat the great empirical term in the moon's motion in the same manner as the smaller terms — It is not safe to assume that either of them follows sine curves; they can be as well represented by a zigzag of straight lines. He notes that his results from Jupiter's satellites are not in harmony with those from the sun, Mercury, and Venus. He suggests that the Jovian system may have fluctuations of its own.

A METEOR TRANSITS THE SUN.—Astr. Nach. No. 5505 contains a note by A. Stentzel of Hamburg, describing an observation of the transit of a round black object, some 18'' in diameter, across the sun's disc from P A.  $120^\circ$  (about) to  $5^\circ$  (about), on Mar. 15 at  $15^\mathrm{h}~25^\mathrm{m}~\mathrm{U}~\mathrm{T}$ . The time of passage was 6 seconds. The object was sufficiently distinct to make certain that it was not a distant bird The observer notes that it is the first undoubted observation of the kind that he has made in twenty-seven years of observing. A very similar transit across the moon was noted by Dr. W. H. Steavenson, a few years ago, and described in the B.A.A. Journal. The rate of apparent motion was about the same in each case. The slowness of the motion makes it probable that the distance, and therefore the size, of 'the object were considerable. Most meteors cross the telescopic field in a small fraction of a second.

#### Research Items.

Edinburgh Folklore —In the Nineteenth Century and After for July, Mr. Lewis Spence publishes the first instalment of a much needed study of the folklore of Edinburgh. He proposes to deal with his study under three heads: (1) Mythology, dealing with traditional material predominantly of a religious character. (11) legendary tradition related to human personages or persons once actually existing; and (m) folklore associated with ritual, popular customs, or superstition. In the first section he shows that the Chapel of St. Triduana in Restairig was in all probability originally a structure erected over a holy well serving as a place of immersion. The shrine with its holy well was a resort of pilgrims for the cure of blindness. St. Triduana is not in the Roman calendar and was probably a Celtic goddess who, on account of the similarity of the legend accounting for her blindness, is to be equated with St. Brigit, the goddess Brigantia of the Brigantes, and Sulina (Gael. Suil, "eye of life"), worshipped at Bath. Brounger, associated with the fishing suburb of Newhaven in popular tradition, was an old fisherman who when he did not fish himself asked for a few fish or oysters from his returning neighbours. If they refused, ill luck followed. He is equated with the thunder god through a tradition connecting him with a flint or meteorite suggesting the holy or lucky stones representing that deity. It is possible that he may be Perunu, the thunder god, of Rugen, linking up through the connexion of the North German fishers with Scotland, and also the Slavonic Bog. A demon, Shellycoat, finds an analogy in Japan only, and a piper who disappeared in a subterranean passage from the Castle to Holyrood recalls the legend of Orpheus and other stories of that class.

A NEW VIEW OF PILTDOWN MAN.—In Man for July, Prof. Frassetto of Bologna figures and describes his reconstruction of the jaw of Piltdown man, which he compares and contrasts with the jaws of the orang and the chimpanzee. In his view its resemblance lies in the direction of the orang rather than that of the chimpanzee. He gives in tabular form eight points m which the orang differs from the chimpanzee, and in which the jaw of Piltdown man, so far as its condition allows, is comparable with it. As a whole the jaw of the chimpanzee is relatively thin, slight, and light, while both orang and Pıltdown are massive and heavy; the ascending ramus is oblique in relation to the horizontal portion, but in the orang and Piltdown almost vertical; the position of the semilunar notch coincides in the two jaws, but in both differs from its position in the chimpanzee jaw; the angle has a curvature of a large radius in orang and Eoan-thropus, but it is small in the chimpanzee; the posterior margin of the chimpanzee ramus is narrow to the root of the condyle, where it widens rapidly, but in both the other jaws it widens gradually as it passes into the condyle. Again, the lower borders of the corpus of the mandible resemble one another in both orang and Piltdown but differ from the chimpanzee, which also has a relatively small genual fossa as opposed to the large fossa of the other jaws. The reconstruction was therefore made by grafting the symphysian region of the orang's mandible duly enlarged on to the corpus of Piltdown man's jaw, the conclusion being that the jaw is human, belongs to the same individual as the cranial fragments, and represents a primitive race belonging to a genus of the orang type. Not only is this because of the features of the mandible, but also because of the eyebrow ridges, which do not exhibit the prominent torus characteristic of the climpanzee type to which Neanderthal man belongs.

INDUSTRIAL PSYCHOLOGY ON THE FARM.—The National Institute of Industrial Psychology, in Report No. 2, records the results of an investigation into certain processes and conditions on farms undertaken by Mr. W. R. Dunlop. The results would seem to show that farm management in Great Britain is by no means efficient. It is unfortunate that so many discussions on agricultural problems are complicated by political motives. The present investigation is the first systematic attempt in Great Britain to apply the point of view and methods of industrial psychology to agriculture. Two problems were studied (a) the picking and packing of truit, including bush fruit, hops, and glass-house produce, and (b) milking. shown that the best pickers at one kind of fruit are the best pickers at all other kinds, that there is no evidence to show that atternoon rates are lower than those of the morning, that there are considerable individual variations in efficiency. The milking problems include discussions of milking rates, differences of cows, manual skill of milkers. Some very important questions are raised in the third section dealing with future enquiries, not the least of which is the selection of the right worker for the right work. and the guidance of young people leaving school into occupations for which they are most fitted. Apparently there is a tendency for the children of a lower level of intelligence and ambition to take up agriculture, the town attracting the more intelligent. In so far as this is so, it is to be deplored, but obviously the problems connected with such a choice are very difficult to attack, involving as they do the attitude of mind of the community towards agricultural work, the lower standard of nominal wages and the ties with regard to hours.

THE SCIENCE OF ROWING.—Among the papers read at the July meeting of the Institution of Naval Architects at Cambridge was one on "The Propulsive Efficiency of Rowing," by Mr. F. H. Alexander. In welcoming the Institution to Cambridge the Vice-Chancellor, the Rev. G. A Weekes, spoke of the subject of rowing as of particular interest to Cambridge men, especially as it is a matter of controversy at the present time. There are two schools of thought, the old orthodox school and a new school, which has proved very successful over short courses. Mr. Alexander's paper recorded the results of investigations as to the magnitude of the forces employed by oarsmen and the utilisation of those forces, a racing 'eight' and a ten-oared whaleboat being chosen for consideration. Various tables were given showing dimensions, ratios, properties of hull forms, weights of boats and crews, amplitude of the movements made by the crews, the oars and the boats, together with the speeds at different points of the stroke. It will come as a surprise to many to learn that the power developed amounts to so much as  $1.09\,\mathrm{H.P.}$  for each man in the 'eight' and  $0.90\,\mathrm{H.P.}$ for each man in the whaleboat. The efficiency of the total work in an 'eight,' re the ratio of the work done per minute by resistance (91,800 feet-lb.) to the total work performed by the crew (288,680 feetb.) works out at 0318. In the whaleboat the efficiency is only 0221. The paper was accompanied by diagrams, and some of the points raised in the discussion will be dealt with by Mr. Alexander in a written contribution to the Transactions.

Cancer in Europe.—Prof. Eugene Pittard of Geneva contributes an interesting article to the World's Health for June (vol. 8, No. 6) on the distribution of the incidence of cancer among the anthropological races of Europe. Surveying Italy, France, Holland, and Switzerland, the fact seems to emerge that the Nordic race is more prone to be attacked than the Celtic, Mediterranean, and Adriatic races. The last named, which includes the northern Albanians, the Bosmians, Montenegrins and others, seems almost immune from cancer.

THE PARASITOLOGY OF PLAGUE.—In regional studies in the parasitology of plague (Ceylon Jour. Sci., vol. 1, Part 5, 1927) Dr. L. Fabian Hirst remarks that the gradual recession of plague from Europe at the end of the seventeenth century is one of the mysteries of epidemiology Undoubtedly the substitution of the long sea route to the east round the Cape of Good Hope for the journey via the Mediterranean and the overland routes must have played an important part. But, he reminds us, bubonic plague is a disease of rats and the human epidemic is a mere offshoot of the epizootic, and therefore the fact which most requires explanation is the disappearance of the disease among the British rats and its failure to spread continuously when reintroduced among them. The generally accepted theory that the disappearance of plague from Britain is to be attributed to the replacement of the black rat (Rattus rattus) by the brown rat (R. norvegicus) is unsatisfactory, for the cessation of epidemic plague does not coincide with the appearance of R. norvegicus in England—it had been extinct for a generation when (in or about 1728) the brown rat reached England. The conditions prevailing in the wooden dwellings of old London with their large contents of grain, combined with defective scavenging and tolerance of large colonies of rats living in close association with man, amply suffice to explain the intensity of the historic human epidemics which devastated the city at fairly frequent intervals prior to the great fire. The former London plague season— June to December, with maximum prevalence in August and September-corresponds to the period of greatest prevalence of the flea Xenopsylla cheopis in Marseilles and Lisbon at the present day. climatic conditions during plague years seem to have been especially suitable for the breeding of X. cheopis; during the great epidemics of 1636 and 1665 the summer was exceptionally hot and dry. That the disappearance of plague from Britain and Europe generally may possibly be due to a retraction of the area of X. cheopis prevalence is compatible with the

ANTS OF THE CANARY ISLANDS .- In Proc. Amer. Acad. Arts and Sci., vol. 62, April 1927, pp. 93-120, Prof W. M. Wheeler contributes an interesting paper on this subject. He visited each of four of the larger islands during July and August 1925 and was able to collect and observe a considerable proportion of the ants known to occur in the Archipelago. He lists 56 species, subspecies and varieties now known, and by far the greater number have been taken in Teneriffe, the other islands having been little explored by entomologists. Nearly 70 per cent. of the total ant fauna is indigenous to the Canary Islands, while of the remaining forms, twelve are well-known south European and north African insects and five are tropicopolitan species Among the latter the most important is the Argentine ant, Iridomyrmex humilis. Prof. Wheeler mentions that the banana plantations are suffering severely from this pest. Fear of closing the European markets to their produce has prevented the officials from announcing its presence, and Prof. |

Wheeler states that he encountered it in enormous numbers on three of the islands visited. This ant does not attack the banana directly, but owing to its fondness for honeydew excreted by coccids it not only cultivates these sap-sucking insects on the foliage but also transports their larvae from plant to plant

BUTTERFLIES OF SAMOA.—The Trustees of the British Museum have recently undertaken the publication of an account of the Insecta and other terrestrial Arthropoda collected in the Samoan Islands during 1923–24 by Dr. P. A. Buxton and Mr. G. H. E. Hopkins. The material collected was obtained during the expedition of the London School of Hygiene and Tropical Medicine to the South Pacific. The monograph will be divided into eight parts, which will be subdivided into fascicules. latter will not appear in serial order, each one being published as soon as completed. On completion of the work it is intended to issue an introduction, summarising the whole monograph, and drawing from it whatever conclusions as may be warranted. The first study to be issued is Part 3, Fascicule 1 (London: British Museum (Natural History), 1927. 58. Maps No. 1, South-West Pacific; No. 2, Samoan Islands. 6d), dealing with the butterflies of Samoa and of neighbouring island-groups, by Mr. G. H E. Hopkins. It is noteworthy that with the exception of the comparatively recent American immigrant, Danaida archippus, the butterflies inhabiting Samoa and the neighbouring groups of Islands are all Indo-Malayan in origin. Most of them are widely spread through Polynesia and appear to have reached Samoa by way of Fiji.

LIVING CELLS UNDER DARK-GROUND ILLUMINATION.-The late Dr. T. S. P. Strangeways and Dr. R. G. Canti employed dark-ground illumination for the study of the living cell in culture and of the effects of fixing reagents upon the constituents of the cell. (Quart. Jour. Micr. Sci., vol. 71, Part 1, 1927). Cultures of the choroid and sclerotic, heart, kidney, intestine, and skin of the embryonic fowl were em-When growing on the surface of the covership the cell is flattened, has an irregular 'feather-like shape, and shows no true cell-wall, the outline being apparently caused by reflection from the interface between the cytoplasm and the surrounding culture medium. This outline is unceasingly changing, if the culture is observed in the warm incubator, and the cell wanders over the surface of the coverslip by slow amœboid movement. Cells so observed show no nuclear membrane or Golgi apparatus. The centrosphere is seen as a cap over one side or end of the nucleus. The mitochondria appear to be formed in this region and to wander therefrom into the clear cytoplasm. Chromosomes can be distinguished in a dividing cell, but the most careful scrutiny failed to reveal a trace of spindle-fibres. The principal changes produced by fixing reagents were the formation of precipitate in nucleus and cytoplasm and shrinkage of these, distortion or destruction of the delicate cytoplasmic processes resulting in the cell assuming an artificially regular outline, the fusion of adjacent fatglobules, the modification or disappearance of the mitochondria, and the appearance of spindle-fibres in the dividing cell. Of all the reagents tested, 2 per cent. osmic acid produced the least change in the cell. The authors also describe the destructive effect of strong light (from the dark ground condenser) upon cells which had been fixed in a reagent containing chromic acid. The entire cell, with the exception of the fat-globules, was completely dis-

REDIA AND CERCARIA OF FASCIOLA.-W. Rees Wright records (Ann Trop Med. and Parasit. 21, 1927) observations on the redia, cercaria, and cyst of Fasciola hepatica. Thomas's statement that the sporocyst and daughter rediæ are not to be found during late summer and autumn is confirmed; at that time of the year, reduce produce cercarize only. The redia is cylindrical and about 2 mm. long and 0.4 mm. in diameter; its wall is very thin-for the greater part of its surface it is only one cell thick. Delicate muscle fibres, longitudinal and transverse, appear to be present in the wall external to the principal layer of cells. In addition to the simple digestive system there is an excretory system consisting of numerous flame-cells and their ducts, the main groups of flame-cells being near the oral end and near the two processes of the body wall, as Thomas pointed out. The redia, as Thomas indicated, is not a passive parasite, Wright states that in the case of very thin-shelled snails the rediæ may be seen devouring the liver tissue and moving through it Wright describes and figures the position of the seven pairs of flame-cells of the cercaria. The cercaria emerge from the parent redia through the birth pore, find little resistance to their movements in the eroded visceral mass, and escape from the snail through the respiratory aperture. Experiments with encysted cercaries in artificial gastric and duodenal fluids suggest that complete digestion of the cyst walls takes place in the duodenum and not in the stomach. There is no definite evidence to show that Limnæa truncatula is the only intermediate host of Fasciola hepatica in Britain; observations are cited which suggest that L. peregra may also act as intermediate

Non-Marine Mollusca of the Belgian Congo.-During the years 1909-15 the American Museum of Natural History maintained an exploring expedition in the Belgian Congo, under the leadership of Mr. H. Lang. The scientific results of that expedition, so far as the general invertebrate zoology was concerned, were published in the Museum's Bulletin, vol. 37, while a "Review of the Land Mollusks" by Dr. H. A. Pilsbry appeared in 1919 (Bull. Amer. Mus. Nat. Hist., risbry appeared in 1919 (Bull. Amer. Mus. 1746., 1746., vol. 40, art. 1). Now, at long last, there comes to hand the companion volume on "The Aquatic Mollusks... With a geographical and ecological account of Congo Malacology" by Dr. H. A. Pilsbry and Dr. J. Bequaert (Bull. Amer. Mus. Nat. History, and Dr. J. Bequaert (Bull. Amer. Mus. Nat. History, and Dr. J. Bequaert (Bull. Amer. Mus. Nat. History, and St. 1919. vol. 53, art. 2). A bulky volume of 534 pages and 68 plates, with numerous text illustrations, it forms with its predecessor a complete monograph on the malacology of the vast territory of the Congo basin from the Atlantic coast to the great lakes of Central Africa, and will undoubtedly prove the standard book on the subject for many years to come. It is not to the malacologist alone, however, that the work will appeal, for the section on the zoogeography and ecology of the area will interest the general zoologist, and even the botanist and geologist. seems to have been most thoroughly discussed and is well illustrated, text maps are furnished of the whole continent giving orographical details, rainfall, faunal areas based upon the distribution of birds, the hypothetical distribution of lake and river basins towards the close of the Pleistocene period, as well as other charts more immediately germane to the special Twenty-two of the plates, moreover, are devoted to most excellent views of various habitats. The one defect of the whole work, and it is a big one, is the lack of any index. The Museum would do well if it would devote some future number of its Bulletin to an index to both volumes, and so crown what is a most important and valuable work.

NEW AMERICAN AND WEST INDIAN MOLLUSCA. Dr. Paul Bartsch has described some new species of West American marine Gastropoda (Proc. U.S. Nat Mus vol. 70, art. 11), mostly small representatives of the Tænioglossa and Gymnoglossa. The thirty-one species believed to be new, with some previously species believed to be new, with some previously described by the author but not figured at the time, are illustrated on six plates Mr. W. B. Marshall contributes a short paper (*Proc. U. S. Nat. Mus.* vol. 71, art. 6) on "A New Genus and Two New Species of South American Freshwater Mussels." The new genus, Mycetopodella, has been created for the recention of the remarkable elongated form of Unio originally described under the name of Mycetopus falcatus Higgins, but since successively described to several other different genera. The new species are Anodontites guanarensis and Mycetopoda pittieri. Dr. H. A. Pilsbry (Proc. Acad. Nat. Sci. Philad. vol 79) describes Ceratodiscus portoricensis, n sp., a small land mollusc from Porto Rico. The genus has hitherto been known by one species in eastern Cuba and another in western Hayti, so that the new discovery extends the range of this peculiar group eastwards.

Earthquakes in Norway.—The earthquakes of Norway have been studied from the year 1887, and m a recent paper (Bergens Museum Aarboh, 1926) Prof. C F. Kolderup has described those of the years 1924 and 1925. This was a period of unusual infrequency, the yearly numbers being 5 and 8, and also of slight intensity, for only one shock disturbed an area of more than about 1500 square inless. During the twenty-five years 1889–1913, 479 earthquakes were felt in Norway and 358 in Great Britain. Thus, taking the areas of the two countries into account, the frequency of earthquakes in them is almost identical, the ratio being 385 for Norway to 394 for Great Britain.

Microdissection.—The issue of Watson's Microscope Record for May (No. 11) contains matter of considerable interest. Dr. Eric Ponder contributes an article on 'microdissection,' in which by means of fine needles carried in mechanical holders minute structures, such as protozoa and cells, can be dissected while being viewed by the microscope, and any particular element, such as the nucleus, removed. The method is comparatively new and has many possibilities. Mr. G. T. Harris contributes Chapter III. of his studies of the Desmidiaceæ and Mr. W. G. Royal-Dawson details for mounting pollens for the microscope.

DISTANCE THERMOMETERS.—Messrs. Siemens Bros., Woolwich, have just issued a revised list of electrical distance thermometers. Amongst the instruments described are some designed to meet the special requirements of refrigeration, and they reflect the influence of the scientific workers studying problems of refrigeration on the design of technical apparatus for industrial use. One thermometer is intended for use in the refrigerated holds on board ship, and by means of flexible metallic connexion may be fixed in position or removed in a few moments The object is to obtain an accurate measurement of the temperature of the cargo itself, which may differ considerably from that of the air near the refrigerating pipes. Another installation illustrated is a special outfit for a large precooling plant in South Africa. This is fitted with switch gear for connexion to 149 thermometers. In addition, five anemometers are fixed in the air ducts and five anemometer counters are fitted on the top of the board. Another installation which is illustrated was made for a grain elevator plant and was fitted with 900 thermometers.

#### Plankton of the Gulf of Maine.

THE great importance of the small and microscopic animals and plants that drift throughout the water layers in the sea and constitute the 'plankton' is now well established. On the plankton plants, chiefly consisting of diatoms, most of the animal life in the sea is ultimately dependent for its food supply. It is therefore natural that in fishery investigations, when seeking the basal causes of fluctuations in supply of fish, much time should have been spent in a study

of this drifting life.

For the past twenty-five years the European countries attached to the International Council for the Exploration of the Sea have carried out extensive programmes in the regions of the great sea fisheries, no small part of which have been concerned with plankton research. The course of such investigations naturally follows an evolutionary path, and, while the earlier years were spent in classifying the various species and noting their comparative abundance and distribution in different localities, the work is now tending to a more detailed and minute study of those few forms that have been proved, on account of their numbers and prevalence, to be of the greatest importance in the economy of the sea.

Such is the position on the European side of the North Atlantic, but research is not so far advanced in the western Atlantic along the American seaboard. It is only in a recent publication <sup>1</sup> that full details of the preliminary survey necessary to depict the general characters of the plankton, and to point out those species worthy of a more detailed study, are forth-

coming.

The area dealt with in this report is the Gulf of Maine, the oceanic bight from Nantucket on the west to Cape Sable in Nova Scotia on the east. The survey has been very thoroughly carried out and brings out clearly the major fact that the characteristics of the plankton community are essentially the same as those long known to be the case in other boreal

waters of the North Atlantic.

The report, which has been written by that distinguished American oceanographer, Dr. Henry B. Bigelow, is divided into two main portions, the first dealing with the animals of the plankton and the second with the plants. The outstanding feature of the animal plankton is the predominance of the small crustacean copepod Calanus finmarchicus. This small creature is indeed deserving of a wider appreciation by the public, as it forms one of the main articles of food that constitute the links in the chain between plankton plants and fishes. Its abundance is over-awing to the human mind, suffice it to say that in his largest eatch Prof. Bigelow obtained upwards of 2,500,000 individuals by towing a net with a circular opening of one metre diameter through the sea for fifteen minutes. This huge catch shows that the region under observation can hold its own with the richest waters on the eastern side of the Atlantic, the largest catch the present writer is aware of being recorded by Hjort in "The Depths of the Ocean, p. 726, namely, at least 2,000,000 in a ten minutes' haul with a similar net to that mentioned above. Prof. Bigelow gives an instructive chart which emphasises clearly the predominance of this crustacean over other animals in the plankton.

In the catches also appear, in smaller and varying numbers, several species that characterise the collections, notably the copepods *Metridia lucens* 

<sup>1</sup> "Plankton of the Offshore Waters of the Gulf of Maine. By Henry B Bigelow Bulletin of the Bureau of Fisheries, vol. 40, 1924, part 2, Document No. 968, pp. 1-509. Washington, 1926.

and Pseudocalanus clongatus, the 'glass-worm' Saguta elegans, the amphipod genus Euthemisto, the euphausid genera Thysanoessa and Meganyctiphanes; the pteropod Limacina retiorersa, the ctenophore Pleurobrachia pileus, and in deeper water the large copepod Euchæta These organisms are here together designated the 'Calanus community.' Mention should be made of the euphausiid group; these shrimp-like animals are of considerable size compared with the other members of the plankton, Meganyctiphanes reaching a length of an inch or more, and their importance as food for fishes is being increasingly realised. There are few fish from northern waters, indeed, that have not been found feeding on them, and they form the chief food of the whalebone whales, the distribution of which in the Norwegian Sea has recently been shown by Hjort in a preliminary survey (Cons. Intern. pour l'Explor. de la Mer, Rapp et Proc. Verb, vol. 41, 1927, p. 115) to coincide at times with that of Meganyctiphanes. In this connexion Dr. Bigelow gives two interesting photographs of the fringe of whalebone plates, showing how the coarser fringe of the fin-back whale (Balanoptera physalus) allows the smaller animals of the plankton to pass through, the larger organisms, such as the euphausids, alone being retained, while the fine fringe of the bone of the pollock whale (Balænoptera borealis) is able to retain in addition large quantities of the copepod Calanus.

Besides the species mentioned above, all animals present in the collections are dealt with in detail in the report as regards their seasonal and regional distribution. In the work of identification the author received the assistance of Prof. C. B. Wilson, but although relieved of this labour, Dr. Bigelow's report must represent the results of a vast amount

of careful thought and study.

In dealing with the plants, or phytoplankton, for identification of which the author was indebted to Dr. Albert Mann, it is evident that far less information was available than in the case of the animals. Nevertheless, it is sufficient to show that in their general trend of behaviour the plants follow the same course in their seasonal distribution as they do in European waters. There is a very abundant plankton of diatoms in early spring which dies down and is succeeded in the summer months by a less abundant

peridinian plankton.

At the end of this second portion of the report, Dr. Bigelow gives a valuable discussion on the problems connected with the cycle of events characteristic of phytoplankton throughout the seasons, in which a summary of much of the modern literature on the subject is included. The importance of those possible limiting factors in the environment, such as phosphates, nitrates, and silicates, is discussed, but the reader is left with the realisation that much work must be carried out before the various phenomena can be thoroughly understood. Unfortunately, no work on the phosphate and nitrate content of the sea-water comparable to that of Atkins and Harvey at Plymouth, and more recently Marshall and Orr at Millport, has yet been carried out in the region under survey.

Dr. Bigelow is to be congratulated on producing an addition to the literature that will prove invaluable to many plankton workers. The report is illustrated with many beautiful photographic plates reminiscent of those produced by the school of marine biologists at Port Erin, and contains an extremely useful bibliography of 365 titles.

F. S. R.

### Engineering and Technological History.1

THE desirability of preserving and making readily accessible accurate and authoritative information regarding the rise and decay of industries, the development of tools and machines, the evolution of handicrafts, and the lives of the principal actors therein, can scarcely be disputed. With the passage of time mines are abandoned, factories pulled down, machines and tools scrapped, papers are dispersed, and the pioneers often forgotten. Even when manuscripts and drawings are preserved, it is frequently difficult to learn of their whereabouts, and the student is often at a loss to know where to look for original material.

In its efforts to further the study of engineering and technological history by the preservation and publication of such information as that referred to, the Newcomen Society is doing valuable work and has gained for itself a recognised place among the technical societies of Great Britain. The fifth volume of its Transactions is evidence of the wide scope of its activities and the high standard of the matter presented. The present volume contains the papers read before the Society during the session 1924-25 Glass-making, the art of the gunsmith, the windmill in America, the evolution of the boring machine, the Eddystone lighthouses, are among the subjects dealt with. Two other papers on the iron industry of Coalbrookdale bring into proper perspective and correct date the epoch-making work of the Darby family, five generations of which engaged in iron smelting and founding. Both Mr. J. W. Hall and Mr. T. A. Ashton write on this subject, and the latter concludes his review of the work of the Darby family with the following pregnant paragraph: "The first Darby used coke m place of charcoal in the production of castings;

<sup>1</sup> The Newcomen Society for the Study of the History of Engineering and Technology Transactions, Vol. 5, 1924-1925 Pp Ni+139+22 plates (London Newcomen Society, Science Museum, 1926.)

his son converted this coke-smelted iron into malleable iron with charcoal; the Cranages and Henry Cort substituted coke for charcoal in the final process. By so doing they broke the last shackle binding the industry to the woodlands and enabled it to renew its youth on the coalfields of the Midlands, Yorkshire, and South Wales The work begun by Abraham Darby in 1709 was completed by Henry Cort in 1794."

Among other contributors may be mentioned Mr. C. E. Greener, whose knowledge of guns and gunmaking is unrivalled; Sir Flinders Petrie, who illustrates a discourse on ancient glass in Egypt by three plates giving specimens of Egyptian glass before 1200 B c., between 1200 and 300 B c, and between 300 B c. and A.D. 300, Mr. D Brownlie, who recalled a neglected worthy, John Patison of Airdrie (1828–1905), a pioneel in the shale oil industry, while Mr. R Jenkins annotates some letters of the elder

Brunel on boot-making by machinery

A word should be said about the bibliographies that have appeared in the Transactions. Vols. 2 to 4 contained parts of a bibliography of engineering and applied science, compiled by Mr. E. W. Hulme. Most of the items given referred to articles published in periodicals and journals of the last few years. In the present volume is a subject list of books and pamphlets relating to the history of technology published during the period 1920-25. There are several hundred items in the list, which has been compiled by Mr. A. Gomme, of the Patent Office Library, and the value of the list is increased by the insertion of an asterisk against such of the books as are to be found in that library. We trust these bibliographies will be continued, and thus a body of information accumulated which will be of value not only to writers and students of engineering history, but also to others concerned with biography, economics, and commerce.

## Appeal for the University of Sydney.

In its comparatively brief existence of seventy-five years, the University of Sydney has been the recipient of numerous private benefactions. The princely Challis bequest (1880) of £276,000, and the even greater munificence of the late Sir S. McCaughey (1920), have rendered the University much less dependent than its neighbours upon State aid, particularly as the income in each of these instances is available for general purposes. Other noteworthy gifts, including one of £100,000 by Sir P N. Russell, and another of £30,000 by Thomas Fisher, were allocated to specific purposes by the donors.

Such benefactions must doubtless be numbered among the chief factors which have brought about a development so rapid that the University "now finds itself in a more critical position than ever before, . . . its resources have not kept pace with its requirements." This quotation is taken from a pamphlet which has been issued recently by the University authorities under the title of a "75th Anniversary Appeal" for further funds. According to the facts set down therein, the University of Sydney, with an enrolment of 2490 in 1925, must be included among the major universities of the Empire. The teaching staff, however, numbers only 217; on the Liverpool scale itshould be increased to 364, and on the Manchester scale to 452. A further handicap is discerned in an exhibition system which exempts 200 undergraduates per annum from fees, for a maximum period of 5

years, in return for a yearly Government grant of £20,000. Since, in addition, all teachers and intending teachers are entitled to a similar remission, there were 1084 students in 1926 who paid no tuition fees. The fees payable by other students average £25 per annum in the Faculty of Arts and nearly £40 in the Faculty of Medicine.

The Government of New South Wales has been liberal in granting a sum of about £50,000 per annum over a period of several years for the provision of newbuildings, in strengthening existing departments, and in establishing new ones. The creation of new chairs, however, seems to have contributed considerably to the mounting expenditure. Owing to the adoption of the Workers' Compensation Act, the rise of wages, and the increased number of employees, the payments for attendants and laboratory assistants have risen by £7777 since 1922. Thus, although nominally wealthier, the University is relatively poorer, and in spite of a general services fee of a guinea a term which has been levied, not without protest, on every student, the present year will probably close with a deficit of some £8000.

Meanwhile, many claims press for fulfilment in connexion with (1) grounds, roads, and buildings, (2) sport, (3) the library, and (4) maintenance and research. The new chemistry building is still incomplete, pathology, pharmacy, and psychiatry are inadequately accommodated; the additions to the

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library are unfimshed; and "the University grounds give the impression of shabbiness and neglect." Further, the McCaughey Research Fund of £1000 per annum, from which grants were formerly made to teachers and graduates of the University, has been in abeyance since 1923. At the present time, apart from the question of future expansion, it is estimated that an additional revenue of more than £12,000 per annum is needed to enable the University to discharge all the functions that properly belong to it.

The University of Sydney, though young in years, is rich in achievement. Australia suffers from no lack of public-spirited citizens, and we hope that this appeal from one of the greatest centres of learning in the southern hemisphere will evoke an adequate response.

### University and Educational Intelligence.

CAMBRIDGE.—Mr. L. E. S. Eastham has been appointed lecturer in advanced and economic entomology

Mr. L. H Wilson, Emmanuel College, has been elected to the E. G. Fearnsides research scholarship on the organic diseases of the nervous system.

Dr E. H. Minns, fellow of Pembroke College, has been elected Disney professor of archælogy.

LEEDS.—The Court of the University has decided to confer the following honorary degrees on the occasion of the meeting of the British Association in Leeds in September next,—Doctor of Laws (LL D.): Sir Arthur Keith, president of the British Association; the Duchess of Atholl, and the Hon. Sir Charles Parsons. Doctor of Science (D.Sc.): Dr. J. S. Haldane, Dr. N. V. Sidgwick, Dr. F. O. Bower, and Dr. R. A. Millikan, of the California Institute of Technology, Pasadena. Doctor of Philosophy (Ph.D.): Mr. James Graham.

London.—The following doctorates have been conferred. D Sc. in botany on Major T F Chipp (Birkbeck College) for a thesis entitled "The Gold Coast Forest: a Study in Synecology"; D Sc in chemistry on Mr P. B. Ganguli (University College) for a thesis entitled "Studies in Colloidal Chemistry." Mr. E. S Hedges (Bedford College), for a thesis entitled "Periodic Electrochemical Phenomena." and Mr. S. J. Lewis (University College), for a thesis entitled "1. The Ultra-Violet Absorption Spectra of Blood Sera. 2 The Ultra-Violet absorption Spectra and the Optical Rotation of the Proteins of Blood Sera. 3. A New Sector Spectrophotometer": D.Sc in physiology on Dr. A. S. Parkes (University College), for a thesis entitled "On the Occurrence of the Oestrous Cycle after X-ray Sterilisation"; D.Sc. in zoology on Mr. C A. Hoare (London School of Hygiene and Tropical Medicine), for a thesis entitled "Studies on Coprozoic Chlates"; D.Sc (Engineering) on Mr. A C. Vivian (Imperial College (Royal School of Mines)) for a thesis entitled "The Preparation and Purification of Beryllium."

It has been resolved to institute an Academic

Diploma in Biology.

The title of reader in philosophy in the University has been conferred, as from September, on Miss L. S. Stebbing, in respect of the post held by her at Bedford College. Miss Stebbing studied at Girton College, Cambridge, and at King's College, London. Since 1924 she has been lecturer in philosophy at Bedford College, London. Her published work includes "Pragmatism and French Voluntarism" (Camb. Univ. Press, 1914), and numerous articles in Proc. Aristot. Soc., Mind, and other philosophical journals.

MR GEORGE F O'RIORDAN, Principal of the Leicester College of Technology since 1924, has been appointed Principal of the Battersea Polytechnic in succession to Dr R H Pickard, who has accepted the post of Director of the British Cotton Industry Research Association.

A SENSIBLE Heat Distillation, Ltd., Coal Research Fellowship at the Imperial College of Science and Technology is being offered to candidates possessing a first-class university degree with chemistry as principal subject and intending undergoing two years' research training leading to industrial work in coal carbonisation. The value of the fellowship is from £175 to £200. Applications must reach the registrar of the College by Aug. 31.

From the National University of Ireland we have received its Calendar for 1927, a bulky volume of nearly a thousand pages. A summary of examinations at the constituent and recognised colleges in 1926 gives the following total numbers of students examined: at University College, Dublin, 1236; Cork, 525; Galway, 242; St. Patrick's, Maynooth, 166. Candidates admitted to the degree of B.A. were: Dublin, 92; Cork, 36, Galway, 7, Maynooth, 74. The other degrees granted were chiefly medical (146), commerce (63), and science (56). Four valuable travelling studentships (£200 a year for two years) were awarded in economics, experimental physics, modern languages, and agriculture, respectively.

A PAMPHLET on "Education in the United States," prepared under the direction of the Commissioner of Education for the Pan-Pacific Conference, 1927, has reached us. Its twenty-five pages provide a very useful summary, concise but comprehensive, of the organisations concerned with education in that country of all grades from kindergarten to university and the various types of adult education. The statistics are elucidated by interesting comments on recent developments. The traditional demarcation between the elementary and the secondary or high schools tends to give place to the 6-3-3 plan, consisting of six annual grades above the kindergarten followed by a three-years junior high school (for pupils of from 13 years to 15 years) which, in turn, leads to a three-years high school (ages 16 years to 18 years). This is designed to meet the special needs of the years of adolescence and to afford, especially for those who are not destined to complete the high school course, a better preparation for life than is possible under the old 8-4 scheme About one secondary school in every six is now organised according to the newer plan. Among other recent developments noticed are: school consolidation, or the uniting of several small schools in one, which is proceeding at the rate of one thousand a year; consequential schemes for the transportation of pupils at public expense amounting now to more than thirty million dollars annually; the increase since 1920 in the proportion of men teachers in elementary and secondary schools; advancement of professional requirements for teaching; extended use of the 'project' method in teaching; co-operation of pupils' parents; increase in industrial and trade courses in secondary schools; municipally supported colleges and universities; adjustment of college entrance requirements with the aim of selecting the more gifted students; junior colleges offering the first two years of work of the ordinary four-years college; approximation of standards for all colleges and universities.

### Calendar of Discovery and Invention.

August 7, 1807.—The famous Bell Rock Lighthouse, which was begun on Aug. 7, 1807, and completed in 1811, was the greatest work of Robert Stevenson. Modelled after Smeaton's Eddystone tower, it is 112 feet high and 42 teet in diameter

August 8, 1793.—Founded by Colbert in 1666, the Paris Academy of Sciences with similar institutions on Aug. 8, 1793, was suppressed by the Committee of Public Safety. Two years later, however, saw the founding of the Institut National des Sciences et des Arts.

August 9, 1831—The first locomotive that ever ran on commercial service in the United States was the Stourbridge Lion, built at Stourbridge, England. The most famous of early American passenger engines, however, was the De Witt Clinton, which on Aug 9, 1831, ran from Albany to Schenectady, a distance of 17 miles, attaining a speed of 30 miles an hour.

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August 10, 1675.—The founding of a Royal Observatory by Charles II. was due to the representations of Flamsteed, Sir Jonas Moore, Sir Christopher Wren, and others. Various sites were considered, but at Wien's suggestion Greenwich Hill was chosen. The warrant for the building was dated June 2, 1675, the first stone was laid on Aug. 10, and eleven months later Flamsteed took up his residence in the observatory. Towards the building the King gave £500, while some of the bricks came from Tilbury Fort.

August 10, 1846.—The famous Smithsoman Institution of Washington came into being by an Act of Congress approved on Aug. 10, 1846. James Smithson, the founder, an illegitimate son of the 1st Duke of Northumberland, died at Genoa in 1829, leaving a fortune of more than £100,000 to a nephew for life, and then to the United States of America, to found at Washington, under the name of the Smithsoman Institution, an establishment "for the increase and diffusion of knowledge among men." The motives which actuated Smithson will probably never be known, for practically all his personal papers were destroyed in a fire in January 1865. Smithson was buried in the English cemetery at Genoa, but in 1904 his remains were removed from Genoa and now rest in a small chapel in the Smithsoman Institution.

August 11, 1716.—In the London Gazette for Aug. Il-14, 1716, an advertisement appeared to the effect: "Whereas the invention for raising water by the impellant force of fire, authorised by Parliament, so lately brought to the greatest perfection . . . as is demonstrated by diverse engines of this invention now at work in the several counties of Stafford, Warwick, Cornwall, and Flint . . . if any person shall be desirous to treat with the proprietors for such engines, attendance will be given for that purpose every Wednesday at the Sword Blade Coffee House in Birchin Lane, London. . . ." This is probably the earliest advertisement of the Newcomen beam engine, the oldest of all practical steam engines.

August 11, 1877.—It was on the night of Aug. 11, 1877, that Asaph Hall, with the large telescope at Washington, first caught a glimpse of one of the small satellites—Phobos and Deimos—of Mars. A few days later he was able to observe both satellites.

August 12, 1851.—Numerous as were the inventors of sewing-machines, it was Isaac Merritt Singer who made the first practical machine and also achieved commercial success. Singer's patent was dated Aug. 12, 1851, and the well-known firm bearing his name was founded in 1856. By 1863 the sales numbered 21,000 annually; by 1878, 350,000; by 1896, 800,000; while to-day the number has grown to between two and three million.

E. C. S.

#### Societies and Academies.

#### DUBLIN.

Royal Dublin Society, June 28.—J Reilly and (i. Pyne· A modified micro-method for the determination of molecular weights. This depends on the alterations in the cooling curve of pure camphor produced by minute amounts of dissolved substances. The method is particularly useful for substances the low solubility of which in camphor, or their high molecular weight, precludes the use of the ordinary Rast method.—J. Wilson: Lord Morton's quaggahorse hybrid. Was it a hybrid?

#### Edinburgh.

Royal Society, June 20.-T. J Jehu and R M. Craig. The geology of South Harris In the Archæan complex are two well-marked bands of paragnesses which include crystalline limestones, quartz-schists, graphite-schists, garnetiferous sillimanite-gneisses, and garnetiferous kyanite-gneisses. With these are associated hornblende-schists and gneisses and hornblende-pyroxene rocks which are probably of igneous origin These appear to be the oldest rocks in the district. Between the bands is an intrusive igneous complex ranging in character from an anorthosite-gneiss to a gabbro-diorite and eclogite. Belonging to the same period of intrusion are ultrabasic bands found in various parts of the island. The north-western part of the area is made up of a granite-gneiss which sends tongues and bands into the neighbouring rocks, and associated with this granitegneiss are abundant pegmatites Along the eastern margin of South Harris there is evidence of crushing and shearing with the formation of mylonites at places—Robert Campbell and J. W. Lunn: Tholentes and dolerites of the Dalmahoy syncline. An account of the petrology of a suite of cognate intrusions associated with the Cementstone group and the Lower Oil Shale group of the Scottish Carboniferous. The rock types represented are basalts, tholeines, and dolerites all closely related to mugearites and essexites. They contain favalite of late crystallisation associated with primary quartz, and are noteworthy also for their richness in chlorophæite. They are regarded as hypabyssal equivalents of the mugearitic and other They are regarded as alkali basalts of Lower Carboniferous age found at Corston Hill and elsewhere in the Edinburgh district.

—Cyril Crossland: Marine ecology and coral formations in the Panama region, Galapagos, and Marquesas Islands, and the atoll of Napuka. The three regions described are sharply contrasted in climate, geology, flora, and fauna. Panama and the islands off its coast have a littoral fauna of great richness, but an extraordinary absence of alge. In the Galapagos alge abound, Sargassum in places giving the shores a temperate rather than tropical appearance. There are small coral flats in the Panama islands, but these are made of one species of Pocillopora, are unconsolidated, and would be thrown on to the beach in any sea of less continual calm. No coral deposits were found in the Galapagos (pace Agassiz), but considerable quantities are thrown upon certain beaches. The absence of reefs round the Marquesas has often been remarked. The coral fauna is greatly restricted, only five genera with twelve species being present, so that the problem is, after all, one for the biologist. These species belong to the Indo-Pacific fauna, not to that of the eastern side of this ocean. There are no true reefs in the group, the nearest approach to one being a structure which is probably unique. It consists apparently of one huge colony of a massive Porites, and therefore the whole reef has

grown from a single ovuin. In the atoll of Napuka an ancient reef flat was found about two feet above the present sea-level, and the actual reef is an erosion flat, a foot or so above the present level of growth. It appears to be undergoing destruction by the sea — W. G. Thomson: On the discharge of a condenser through a gas at low pressure. Observations were noted of the flash which frequently occurs in a discharge tube at low pressure when the electrodes are connected with the terminals of a charged condenser. Photographs of single flashes were shown. Spectrograms of the flash were obtained in air and in hydrogen. The former consisted mainly of lines of the spark spectrum of air, while in the latter, many lines of the second spectrum were identified.—E L. Ince: Researches into the characteristic numbers of the Mathieu equation (in)

#### IPSWICH.

Prehistoric Society of East Anglia (at the Royal Anthropological Institute), May 24.—J. E. Sainty: Acheulean flaking site at Whitlingham, Norfolk Report on excavations on behalf of the Sladen Trust Few palæolithic implements have been recorded from the Norwich district, but this site, discovered by the author and Mr. H. H. Halls, was exceptionally prolific. 550 artefacts were recovered in all, including 173 hand-axes. The implementiferous deposit was part of the 50-foot terrace of the River Yare. An upper clayey loam yielded sporadic specimens showing Le Moustier technique: one large end scraper of grey flint being of the well-known "High Lodge " character. Sterile ferruginous sand, stony gravel, and shelly sand underlay the Moustier horizon and separated it from a bed of gravel one to three feet thick, about eight feet below surface, which proved to be the main implement-bearing horizon. implements show little if any sign of abrasion; several are of large size and range from  $10\frac{1}{2}$  inches in length downwards. Species of Chellean character, heavily abraded and striated, are also present and point to an ice advance between the period of that culture and the time of the Acheulean industry .-J. Reid Moir: Report on excavations at Hoxne made on behalf of the British Association and Sladen Trustees in 1924 and 1926. The results obtained confirmed the main facts observed in the British Association Committee researches conducted by Clement Reid in 1895-96, and produced important new evidence. The lacustrine beds of Hoxne rest in an ancient basin eroded in the surface of the Kimmeridgian Boulder Clay, and the implement-bearing horizon is later than the arctic plant-bed which overlies the 'temperate' clays filling the bottom of the basın. These lower deposits appear devoid of human artefacts, but St. Acheul hand-axes occur in thin gravel seams at the base of the brick-earth which covers the arctic plant-bed. The implements are slightly rolled and agree with those illustrated in Frere's classic paper of 1797, so that the gravel in question was probably the source of the implements which he reported upon. In the brick-earth itself, above the gravel, traces were found of a 'floor' of early Le Moustier date with hand-axes of black unrolled and unchanged flint. The early Le Moustier brick-earth is in turn sealed in by a contorted material of glacial origin containing 'erratics' and broken and striated implements of various ages down to that of Le Moustier; the deposit itself being correlated with the Upper Chalky Boulder Clay of East Anglia. The interglacial age of the lower palæolithic industries of St. Acheul and early Le Moustier times is thus taken to be established for this region and the second interglacial stage of East Anglia is indicated.—Miss Layard: A late

palæolithic settlement in a river terrace of the Colne, Essex. Numerous small flake implements occur at depths varying from 11 it. to 2 it in water-laid gravels. They strongly resemble the more familiar continental cave industries of this period, and are fashioned out of pebbles rather than mined flints. The unrolled condition of the flints and the numerous cores found indicate a settlement. Small hearths have also been discovered Characters belonging to both Aurignacian and Magdelenian work are noticeable. At the same time there are certain original characteristics which may be provincial. The occurrence of some more or less celt-like tools, in close connexion if not belonging to this industry, makes it probable that they should be placed at the very end of the Upper Palæolithic period, and it has been suggested that they approximate most nearly to the Maglemosean culture. A fine feuille de laurier of undoubted Solutrean workmanship was also discovered in a lower stratum of the same section -H. F. Dowie: Further excavations in Kents Cavern. In the second season's excavations the removal of six feet of cave-earth underlying the stalagmite floor revealed fints and fauna similar to those from above it. Three human teeth discovered have been stated by Sir Arthur Keith to be Upper Palæolithic. The flint implements discovered last year have been variously regarded as Middle and Late Aurignacian. No palæolithic hearth or workshop, or any surface definable as a 'floor,' has been discovered. Re-sortment and mixture of deposits has probably occurred owing to flooding. The recent reclassification by the Abbé Breuil of harpoons of Magdalenian 6, results in placing the uniserial specimens with trapezoidal barbs found in the upper levels in 1866, at the very end of that period, and they are further stated to be Maglemose types. The brachycephalic skull found at Kents Cavern is similar to skulls found in Aveline's Hole, and possibly at Cresswell, which seem to appear first in Great Britain in a milieu of Late Magdalenian implements in bone and horn and a flint industry with survivals of Late Aurignacian types and a tendency to geometric forms.—S. Turner Report on discovery of worked flints at Stone Cross Farm, Luton, Kent. A considerable number of white patinated flints apparently of palæolithic character, including one definite ovate hand-axe, were found. They were battered, and indicated much exposure. They occurred in a patch of gravelly material which had been covered by about six feet of clay-with-flints. The cultural affinities of the specimens are problematical and their characters peculiar.

#### PARIS.

Academy of Sciences, June 27.—Marcel Brillouin: The field of exterior gravitation and densities in the superficial layer of the globe. The question of isostasy.-H. Douvillé: Some episodes in the formation of the Pyrenees.—Gabriel Bertrand and D. J. Perietzeanu: The relative proportions of potassium and sodium in plants. The amounts of potassium in the fresh plant, in the dry material, and in the ash are given for 35 species of plants. The ratio potassium/sodium for the same plants is also given, this ratio varying from 1040 to 1.15.-A. Blondel: A method of synthetic discussion of the conditions of working of steam turbine governors.-Paul Helbronner: The common sides of the Avignon parallel and the southern chain of the French Alps. A discussion of the accuracy of the geodesic networks connecting the Lake of Geneva with the Mediterranean.—Leonardo Torres Quevedo was elected an associé étranger in succession to the late Kamerlingh Onnes.—E. Cartan: Certain remarkable Riemann forms

of geometries with a simple fundamental group.—L. Feraud A generalisation of the point correspondences which establish projective applicability - Maurice Gevrey: Problems at the limits of the elliptic type; the case of contours with angular points —M Lavrentieff. A problem of P. Montel —D. S. de Lavaud The fundamental critical velocities of a motor-car. —Robert Esnault-Pelterie: Methods and apparatus for the measurement of Hertzian hardness. The Hertz definition presupposes a transparent and brittle body: the author uses a modified definition which is applicable to opaque bodies, and especially to hard The hardness is measured by the pressure  $p_m$  at the centre of circle of contact of two equal spheres of radius r=1 at the moment when the diameter of contact ceases to follow the law of Hertz  $d=1.761 \stackrel{3}{\sim} \overline{Fr/E}$  (F in kilograms, r and d in em., E in kilograms per sq. cm.). Two methods of carrying out the experiment are described and data given for quartz and for various steels.-Raoul Ferrier: The two magnetic moments of the atom A discussion of the effects of the discordance between the Bohr moment (M) and Weiss moment (M')—Félix Michaud: Binary mixtures of volatile liquids. The case where the molecules of one of the components are partially associated.—Ny Tsi Ze: The electrical deformations of quartz.—C. Mihul: The structure of the second order spectrum of carbon (C II).—Maurice Auméras: The conductivity of hydrofluoric acid. A repetition of W. Ostwald's experiments on the electrical conductivity of hydrofluoric acid, with special care in the purification of the acid, gives values for the constant k lower than that of Pick  $(7\cdot2\times10^{-4})$ .—A. Sanfourche and B. Focet: The decomposition by water of monocalcium phosphate (CaH<sub>4</sub>(PO<sub>4</sub>)<sub>2</sub>. H<sub>2</sub>O).—Paul Bauret, Albert Portevin, and Pierre Chevenard: Alloys suitable for resisting the effects of an alternating temperature gradient and, in particular, alloys suitable for fine glass moulds .-Mile. M. Quintin: A relation between the activity of the hydrogen ions H<sup>+</sup> and that of metallic cations in a solution of salts of the heavy metals. It is shown that in solutions of the sulphates and nitrates of zinc, cadmium, and copper, the activity of the metallic ion is, for all concentrations between M/2 and M/2048, proportional to that of the ion H+.-P. Vaillant · The rôle of the intensity of the maximum absorption in the displacement of Kundt.-Jacques de Lapparent: The hydrated alumina of bauxites.—F. Dienert: The sources of the alluvial water of the Loire valley.-M. Lenoir. The observation of the pollen kinesis in living Lilium candidum. These observations on the living specimen show that the hetero-homeotypical scheme, established from the study of fixed and stained preparations, is perfectly exact.—M. Bridel and Th. Aagaard: The diastatic hydrolysis of turanose. Turanose is not hydrolysed by emulsin, rhamnodiastase, or the autolysate of high yeast, but low yeast causes the rapid hydrolysis of this glucoside. This is not due to the sucrase present but to an active  $\alpha$ -glucosidase. Turanose is a glucoside of fructose. - Marcel François and Henri Piéron: Sensations of apparently internal heat are of cutaneous origin (experiments by the diathermal method).—Raymond-Hamet: The splenic vasomotors.—H. Hérissey: The extraction of asperuloside from Galium verum. The probable presence of this glucoside in numerous plants of the Rubiaceæ family.—E. Aubel and L. Genevois: The oxidation-reduction potential of yeast, of Bacterium coli, and of the media in which these micro-organisms increase. - J. Cantacuzène and O. Bonciu: Some peculiarities relating to filtered scarlatina products.—J. Giaja, X. Chahovitch, and A. Giaja: The absence of fever in the rat deprived

of the suprarenal capsules Rats after removal of the suprarenal capsules suffered no temperature rise when inoculated with a culture of the pyocvanic bacıllus

#### CAPE TOWN.

Royal Society of South Africa.—April 20: M. R. Levyns . A prelumnary note on the Rhenoster bush (Elutropappus Rhinocerotis) and the germination of its seed. Under natural conditions the Rhenoster bush has no power of reproducing itself, its spread is largely due to man's influence, veld-burning being an important factor.—William Adam Jolly: On some defensive reflexes. The reflexes obtained in the hind limb of Xenopus on stimulation of one or both feet are discussed.—E. Newbery: Note on overvoltage prob-Modern improvements show that transfer resistance is a real quantity and therefore that the direct method of measuring overvoltage is incorrect. These improvements are mainly in the reduction of the time interval between the interruption of the main current through the cell and the measurement of the single potential of the experimental electrode the original work this time interval was 0 02 second; it has been reduced to 0.002 second (Glasstone), 0 0001 second (Sand), and finally the cathode ray oscillograph reduces it to 0.000001 second The results are all explainable on the hydride theory of over-Transfer resistance is in itself a complex voltage quantity, due chiefly to the resistance of a film of gas covering the electrode surface, but partly also to the presence of a partially exhausted layer of electrolyte surrounding the electrode —K. H. Barnard: Some South African Crustacea. Three species of Crustacea are known to be injurious to pier-timbers immersed in the sea in South Africa. Two are cosmopolitan: Lumnoria lignorum (the Gribble) and Chelura terebrans. These are not more than a quarter of an inch in length. The third species is Sphæroma walkeri, which is common in India and seems to be spreading down the east coast in to Natal. It reaches half an inch in length and is capable of rolling itself into a ball.

#### COPENHAGEN.

Royal Danish Academy of Sciences and Letters, Mar. 25.—Martin Knudsen: The hot wire manometer. A rational construction is given, and a series of measurements have shown that this method, for a certain interval of pressures, gives greater relative exactitude than any other method.

April 8.—C. Juel: Von Staudt's definition. After reviewing the different forms in which this definition for imaginary elements has been given, the definition for projectivity is considered, and imaginary elements

are also discussed.

April 22.—Th. Mortensen: The postlarval development of some cidarids. The study of a series of young stages of Eucidans metulana proves that the interradial plates on the peristome of cidarids are not homologous with the interambulacral plates of the test. The periproct is never covered by a single large anal plate. The embryonal spines do not develop into the adult type of spines, but are dropped in the course of growth of the animal. The young Goniocidaris umbraculum is unique in having a bundle of spines, instead of a single spine, attached to each tubercle.

May 6.-Martin Knudsen: The thermal molecular pressure. The condition of equilibrium in a gas enclosed in a circular cylindrical tube the ends of which are kept at different temperatures, will ordinarily be that the pressure in the gas has the same value at both ends At low pressures deviations

from this law arise, and at very low pressures the law becomes completely altered. The author has investigated this phenomenon by a series of measurements and given a formula valid for all pressures.—
J Lindhard. The respiratory quotient during shortperiod muscular exercise. It has been maintained
that the real respiratory quotient during shortperiod muscular exercise is 1, that is to say, the work is performed on the expenditure of carbohydrates exclusively. Experiments now in hand show that this contention is untenable.—J. Hjelmslev. Invariant theory of power series. An independent and complete invariant system for power series of any number is stated as a convergence problem. The corresponding invariant theory comprises and simplifies the well-known theory of the differential invariant. It has also wider applications where the usual conditions for constancy or differentiation are not valid.

#### GENEVA.

Physics and Natural History Society, May 19 .-M. Gysin. On the chemical and mineralogical constitution of the limestones of Saint Best (Pyrenees). A chemical and petrographical examination confirms the hypothesis of MM. Bertrand and Longehambon on the metamorphic origin of these rocks of Urgoaptian age. The clay limestones have recrystallised with formation of silicates. The other minerals are due to fumerolles arising from the neighbouring grantes.—E. Briner and A. Schidlof. The boilingpoint paradox. As the result of their previous studies the authors arrive at the conclusion that it is the osmotic work of dilution of the vapour which provides the compensating work.—B. P. G. Hochreutiner: A new Australian species from Java. The author has collected in Java, at heights exceeding 2000 metres, a Cynoglossum which he connects with Cynoglossum australe, indicated by Bentham in the south of Australia, the province of Victoria, New South Wales, and Tasmania.

#### ROME.

Pontifical Academy of Sciences, April 24.—Wirtinger: Modern mathematics.—Hagen: Symmetry in the theory of surfaces. A problem, as yet unsolved, on a singular symmetry in the so-called Weingarten's identity.—Serini: Elastic co-actions. Various considerations of great importance to the technics of constructions are propounded.—Caronia: Di Cristina's new views on the processes of the defence of the organism against infections. According to these views, the infective process requires sensitiveness of the organism to the infective agent. Cure is associated with a process of de-sensitisation, which may be brought about artificially by special methods.— Teofilato: Investigations on the most suitable longitudinal profile of an aerodynamic tube.—Giorgi: Note on wave-filters.—Ernesta Porcu-Tortrini: Calculation of the powers of motors of the second order by reduction to the canonical form.—Neviani: Cheilo-porina circumcineta. The history of this species, discovered by the author, is summarised and co-ordinated with observations of other investigators.—Bresadola: (1) Selecta mycologica; (2) Basidiomycetes Philippinenses.

#### SYDNEY.

Linnean Society of New South Wales, April 27.—A. S. Hitchcock: Two new species of Setaria from Western Australia.—R. Greig-Smith: The influence of certain colloids upon fermentation. (Part iv.) Agar fibre in the alcoholic fermentation. Agar fibre, when in sufficient amount, accelerates the fermentation of invert sugar and thus falls into line with the

mineral colloids. (Part v ) Old or heated yeast cells are not stimulated by fullers earth (Part vi.) The non-adsorption of the invertase of heated yeast by fuller's earth. Heating the yeast to near the lethal point does not inhibit the production of an inverting substance, but this is indifferent to the presence of fuller's earth. Normal yeast under the same conditions secretes invertase, which is partly adsorbed by the mineral colloid—I. M Mackerras. Notes on Australian mosquitoes (Diptera, Culicidæ). (Part 1.) The Anophelmi of the mainland. New locality records and life histories are given, and the hitherto unknown male of A. atratipe Skuse is described.—Miss Lesley D. Hall · The physiographic and climatic factors controlling the flooding of the Hawkesbury River at Windsor. Two causes of recent decreases in height and frequency of floods suggested are (1) the building of dams on the Upper Nepean, and (2) a natural diminution in precipitation.

#### VIENNA

Academy of Sciences, May 5.-B. Sander: Report on results of the analysis of strata undertaken in the institute of mineralogy and petrology at Innsbruck.-E. Philippi, R. Seka, and others: The oxidation of charcoal with sulphuric acid. Pyromellitic acid was obtained from various samples of charcoal, also carbon monoxide. The action passes from a phase of strong oxidation and abundant sulphur dioxide to one of decreased oxidation with increase of oxides of carbon. —L. Schmid: The sterines of coltsfoot (Tussilago farfara) —A. Duschek: The relative theory of surfaces —B. Zekert. The coloration of rock-salt and of kunzite by Becquerel rays. The rate of change depends on temperature.— E. Kara-Michailova: Brightness of scintillations and possibility of counting with magnetically deflected H-rays of various velocities.—O. Dischendorfer and W. Danziger: The oxidation of  $\beta$ -naphthol.

May 12.-L. Kolbl: The tectonics of the boundary region between west and east Sudetes .- G. Ortner: The  $K\beta$  lines of the elements of the iron series II. In the X-ray spectra of cobalt and nickel lines the  $K\beta^1$  and  $K\beta_1$  can be separated.—R Weiss and S. Luft · Derivatives of 1, 3-diphenyl-hydrindene.

May 19.—F. Hernier: Substitution in the phenyl nucleus of phenyl-1-dimethyl-3, 5-triazole-1, 2, 4.—M. Kohn and F. Rabinowitsch On 2, 4, 6-trichlor-3-bromophenol and 2-chlor-4, 6-dibromophenol.—M. Kohn and F. Rabinowitch: Dibromo-o-cresol formed by the action of aluminium chloride on tetra-bromoo-cresol —A. Duschek. Lines of curvature of Monge's surfaces.—F. Kerner-Marilaun: The climatic threshold value of the complete laterite profile.

### Official Publications Received.

Cambridge Observatory

Annual Report of the Observatory Syndicate,

10.2 May 19—10.27 May 18.

The British Mycological Society

Transactions

Edited by Carleton

Rea and J. Ramsbottom

Vol. 12, Parts 2 and 3, 30 June. Pp. 70-230

(London Cambridge University Press). 15s net.

The Journal of the Institution of Electrical Engineers

Edited by

P. F. Rowell

Vol. 65, No. 307, July. Pp. 653-732+xxx. (London:

E and F. N. Spon, Ltd.). 10s. 6d.

Loughborough College, Leicestershire

Pp. xv. +238-67 plates (Loughborough). 2s. od. net

Magnetical, Meteorological and Seismographic Observations made at
the Government Observatorics, Bombay and Alibag, in the Year 1922.

Under the Direction of Dr. S. K. Banerji. Pp. iv. +68+5 plates. (Calcutta:
Government of India Central Publication Branch.). 7 o rupees; 11s. 9d.

Durban Corporation. Art Gallery Report for the Municipal Year ended
31st July 1926. Pp. 6. (Durban)

The Stone Age in India

Being the Sir S. Subrahmanya Ayyar Lecture
delivered on December 10, 1925. By P. T. Sriniyasa Ayyangar. Pp. 11.

+55+4 plates+2 maps. (Madras: Government Press.). 1 rupee.

Aeronautical Resear, a Committee Reports and Memoranda. No 1001 (Ac. 242) The printing of Aeroplaine. By S B Gates and L W Bry inf. Pp. iv+115+0.7 plates 6. bil net No 1000 (Ac. 243) Wind Tunnel Experiments on a Syn metrical Aerofol (Gottingen 4.0 Section) By C N. H. Lock, H. C. H. Townend and A. G. Gadd. (A.3 t. Autogyros, Helicopters and Rotors, 3, A.3 a Aerofoils-General, 100 —T 2040) Pp. 20-30 plates, 1. net. (London H M. Stationery Office)

Journal of the Royal Statistical Society. Vol. 90, Part 3 Pp. x+433-635. (London.) 7. 60

Transactions of the Royal Society of Edinburgh Vol. 55, Part 2, No. 15 On the Feeding Mechanism of Nebulia Bipes. By Prof H Graham Cannon Pp. 250-369. 2. Vol. 57, Part 2, No. 17 The Geology of Gigha, By W J McCalhen. Pp. 391-409. 2. Vol. 57, Part 2, John's Lane, E. Cl. Prospectus of Classes in Boot and Shoe Manufacture and Making, and Leather Goods Manufacture. Day and Evening Classes, Session 1927-8

Pp. 42 (London.)

City of Norwich. The Report of the Castle Museum Committee to the Council 1926. Pp. 26 (Norwich)

British Museum (Natural History). Picture Postcards. Set Cl.9 British Game-Brids, Series No. 1.5 cards in colour (London British Museum (Natural History)). The Forestry the Journal of the Society of Foresters of Great Britain Edited by H. M. Steven. Vol. 1, No. 1. Pp. 130 (London Oxford University Press.). 7 vol.

The Journal of the Textile Institute. Vol. 18, July, Special Issue. Official Record of the Annual Conference of the Textile Institute, held at Bolton, 7th, 8th and 9th June 1927, in association with the Samuel Compiton Centenary Celebrations. Pp. 150+xx. (Manchester.) To members, 2s. bol; to non members, 5s.

The Scientific Proceedings of the Royal Dubin Society Vol. 18 (N.S.), No. 39. Report of the Irish Radium Committee for the Year 1926. By Dr. Walter C. Stevenson and Maurice R. J. Hayes. Pp. 443-470. 3s. Vol. 18 (N.S.), No. 42 (Dubin Hodges, Figgis and Co.; London Williams and Norgate, Ltd.)

Union of South Africa. Department of Agriculture. Bulletin No. 14

FOREIGN

the Air-Bladder of Fish. By Frances M Ballantyne Pp 371-394. (Edinburgh. Robert Grant and Son; London' Williams and Norgate, Ltd.) 3.

Foreign

Depirtment of the Interior U.S. Geological Survey. Bulletin 786-B. Geology of the Cat Creek and Devils Basin Oil Fields and Adjacent Areas in Montana. By Frank Reeves. (Contributions to Economic Geology, 1920, Part 2.) Pp. 11+39-148. (Washington, D.C.: Government Printing Office) 30 cents.

Department of the Interior U.S. Geological Survey. Water-Supply Paper 557 Large Springs in the United States. By Occar Edward Meinzer. Pp. 111-94+17 plates. 30 cents. Water-Supply Paper 558. Surface Water Supply of the United States, 1924. Part 4 St Lawrence River Basin. Pp +147+3 plates 20 cents. Water-Supply Paper 596-A: Methods of Exploring and Repairing Leaky Artesian Wells. Papers by John McCombs and Albert G. Fiedler. (Contributions to the Hydrology of the United States, 1927.) Pp. 11+32+5 plates. 15 cents. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium. Vol. 24, Part 8: The Grasses of Ecuador, Peru and Bolivia By A. S. Hitchock. Pp. v+291-556+vi-xx. (Washington, D.C.: Government Printing Office.) 45 cents. Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 548: Wave-length Measurements in the Arc Spectrum of Scandards, No. 549: Wave-length Measurements in the Arc Spectrum of Scandards, No. 549: Wave-length Measurements in the Arc Spectrum of Scandards, No. 549: Vave-length Measurements in the Arc Spectrum of Scandards, No. 549: Vave-length Measurements in the Arc Spectrum of Scandards, No. 549: Vave-length Measurements in the Arc Spectrum of Scandards, No. 549: Vave-length Measurements in the Arc Spectrum of Scandards, No. 549: Vave-length Measurements in the Arc Spectrum of Scandards, No. 549: Vave-length Measurements in the Arc Spectrum of Scandards, No. 549: Vave-length Mea

Report of the Danish Biological Station to the Board of Agriculture 32, 1926. On the Renewal of the Stock of Plaice in the Baltic Region By H Blegvad Edited by Dr C G Joh Petersen Pp 37 33, 1927. On the Fluctuations in the Quantity of Young Fry among Plaice and certain other Species of Fish, and Causes of the Same, by A C Johansen, On a Spawning Place for Winter Spawning Herring in the Northern Part of the Baltic Sea, by A C Johansen, On the Annual Fluctuations in the Age Composition of the Stock of Plaice—Investigations from the Danish Biological Station, 1923-26, by H Blegrad, Studies on the Biology of the Oyster (O-tree volus), II-IV, by R Spuck Edited by Dr A C Johansen Pp 65 (Copenhagen G E C Gad) Hamburger Sternwarte in Beigedorf Prazessions-Tafeln 1925 o berechnet mit Newcombs Wert der Plazessions Konstante nebst Talein der Besselschen Sternkonstanten Herausgegeben von Richard Ston

Pp vii+196. (Beigedorf.)

#### CALALOGIES

Bulletin No 86 · The New Radiological Department, Royal Infirmary, dimburgh Pp 40. (London. Watson and Sons (Electro-Medical) Edinburgh

Ltd )

Leaflet 2051 Siemens Auto Alaim Device Pp 2 (London Siemens

### Diary of Societies.

#### CONGRESSES.

EMPIRE MINING AND METALLURGICAL CONGRESS

Montreal Meetings, August 22 and 23—Sir Thomas Holland Proposed Review of the Mineral Resources of the Empire—G. M. Carrie and C S Pascoe Magnesia Refractories for Steel Furnaces —A Stansfield Smelting Titaniferous Iron Otes—W A Tooley Portland Cement in Canada—Mining and Metallurgical Practice in Australia—Health Safety Problems

Smelting Titaniferous from Otes—W A Toobey Portland Cement in Canada —Mining and Metallurgical Practice in Australia — Health Safety Problems.

Toronto Neeting, August 25 ard 26—C Johnson Wiuning and Reining of Precious Metals from Sudbury Ores—R C Stanley Nickel, Past and Present—A A Cole The Silver Mining Industry of Canada—J G. Morrow The Cascade Method of Pouring Steel.—A Mavrogordato and H. Pirow Deep Level Mining and High Temperatures.

Winnipeg Meeting, September 3—G. E Cole The Development of Gold Mining in Canada—W A Quince Methods of Eliminating Barren Rock from Ore at the Sub-Nigel Mine—C R Davis, J L Willey, and S E. T. Ewing Notes on the Operation of the Reduction Plant at West Springs, Ltd—E J Laschinger A New Form of Air Meter and the Measurement of Compressed Air Vancourer Meeting, September 14—C. P Browning: Canadian Copper and its Production—F J Alcock and T W Bingay: Lead and Zinc in Canada.—C. J N Jourdan A Brief Review of the Principal Base Metal and Base Mineral Resources of the Union of South Africa—R.

its Production—F J Alcock and T W Bingay. Lead and Zinc in Canada.—C. J N Jourdan A Brief Review of the Principal Base Metal and Base Mineral Resources of the Union of South Africa.—R. Craib Dewatering the Lower Levels of the Simmer and Jack Mines, Ltd.—W S Robinson. Manufacture of Sulphuric Acid by the Contact Process From Zinc Blende Roaster Gases.

Edmonton Meeting, September 20.—R. Strachan, W J. Dick, and R J. Lee The Coal Industry in Western Canada.—J Ness: Petroleum in Canada.—A Docquier, L. Bataille, and R Bectlestone. A Combination of the Baum, the Draper, and the Froth Flotation Systems as applied to the Washing of Coal at the Linis Mine of the Kailan Mining Administration, North China.—A E Cameron. Impact Resistance of Steel at Low Temperatures

Quebec Meetings, September 5 and 26.—J G Ross Asbestos Mining and Milling.—A W Nash. Possible Auxiliary Sources of Liquid Fuel.—A Job. The Sinking and Equipment of the Ventilation Shaft of the Government Gold-Mining Areas.—G W Sharp The Tipping and Guiding of Vertical Skips.—P M Newhall and L Pryce. Improvements in Drilling Efficiency with Jack-Hammers

Sydney Meetings, September 9 and 10.—F. W. Gray Mining Coal Under the Sea in Nova Scotia.—Sir Robert Hadheld The Metal Manganese and its Properties also, the Production of Ferro-Manganese and its History.—Raw Materials for the Iron and Steel Industry in India.—B. Yaneske: The Manufacture of Steel in India, by the Duplex Process.

#### SEPTEMBER 1-4.

Schweizerische Naturforschende Gesellychaft (at Basel) (in 14 Sections) —Presidential Address by Dr F. Sarasin.—Lectures on, iespectively, The Causes and Factors of Morphogenesis, by Prof. A. Brachet; Recent Work and Views in Astronomy, by Prof. L. Courvoisier; The Urals from the Point of View of Geophysics, Geology, and Mining, by Prof. L. Dupare; Paracelsus in Relation to Modern Thought, by Prof. H. E. Sigerist.

#### September 3-10.

International Union of Geodesy and Geophysics (at Prague)

### SEPTEMBER 4-9

International Congress of Zoology (at Budapest).

#### SEPTEMBER 11-17

International Congress of Physics in Commemoration of the Centenary of Volta (at Como).

#### SEPTEMBER 11-18

INTERNATIONAL CONGRESS OF GENETICS (at Berlin).

#### SEPTEMBER 18-OCTOBER 3.

International Congress of Theoretical and Applied Limnology (at



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Publications Receiver

### Science for Citizenship.

PACILE criticism will always find vulnerable points of attack in any educational system. Only a short time ago, much was heard in the popular press of the views of prominent business men on the deficiencies of their office boys. Our educational system was therefore condemned in toto; our vast expenditure on education was adjudged complete waste. While such hasty judgments, based only on partial observation and imperfect evidence, may be set aside as carrying little weight, those who come most closely into contact with the products of the elementary school may still feel that all is not entirely well with education in England to-day. It may be granted that as compared with twenty-five years ago, when the Education Act of 1902 came into force, vast strides have been made. A higher standard is attained, a greater degree of accuracy and a stronger grip of the facts is to be observed, together with less tendency to a parrot-like repetition of the form in which the subject matter has been received. On the other hand, knowledge and inference which depend on that elusive quality, the intellectual flexibility and adaptability which for lack of a better term examiners connote by 'general intelligence,' seem rarely to show an advance commensurate with the improvement in specific branches of learning.

It may perhaps seem at first sight unfair that any educational system should be judged by the product of its lower grades—a product, too, of which the raw material is drawn in a large number of cases from sources which in all their conditions—intellectual, social, and moral—are unfavourable and sometimes entirely inimical to the aims and influence of the school. But it must be remembered that, since the beginning of the present century, what is almost a social revolution—still, however,

encountered while in the formative stage of their

It is not necessarily a mark of carping criticism to hold-indeed it would be idle to deny-that the qualifications of the elementary branch of the profession are still open to improvement in certain directions. but a great step forward has been taken towards the ideal of those who long ago hoped that the majority of teachers in the elementary school would one day hold a degree, not as a cachet in an already honoured profession, but as the outward sign of certain qualities and cultural attainment. What they looked toward in their staff of the future was not a band of specialists, each highly trained in his own subject, but of men and women of wide culture who might introduce into the elementary school a wider outlook and cultivate in the material on which they had to work an intelligence trained to alertness in appreciating the varied aspects of life and knowledge as a function of existence as members of an economic, social, and political community. To this end the secondary school and university courses then seemed the obvious avenue of approach. .

It must, however, be admitted that the trend of events has by no means justified expectation. It is not intended here to enter into a detailed criticism of the system of training teachers, but

the examination of students in training colleges, however logical its decision may be, and eventhough it may continue to inspect and take part in the examination of the technical side of training, the divorce between the examining body and the elementary schools will be complete, while, having in view the character of university courses as they are regulated at present, it may aggravate a tendency towards specialisation which is part a symptom, part a cause of the defects of our educational system as a whole

For many years the training college stood to the elementary school in a relation analogous to that of the university and the public school. For long it was for the brilliant boy or girl in the elementary school practically the only avenue of intellectual advancement Theoretically, it is true, it led to one profession only, but in practice some made it only a means to an end, taking advantage of the general rather than the professional education, and after a few years left the profession to attain eminence in other walks in life The academic side of the training college, from being subservient to the technical as it was when training was first instituted, became more and more important, and with the introduction and extension of university work it has tended, and tends increasingly, to overshadow the function of a training college as an institution of which the aim was not primarily academic. It must in fairness be recognised that this has been forced on the training colleges by the educational antecedents of the students, and no I magate that the academic education

d opportunity who passes

would thus be alleviated. Circumstances, however, have decreed otherwise, and instead of the numbers being fairly well balanced, science has as a general rule become preponderant. While the Board of Education has continued to examine the greater proportion of the students this has been of less moment. Those who were responsible for the general lines of the examination were well acquainted with conditions in the schools. Inspection by the Board of both colleges and schools secured that training should be carried on with a view to the need of schools for certain qualities and capacities in their teachers. When in the near future the Board will no longer be responsible for

laid down  $\omega$ . utes the most suitable  $\mu$ .  $\nu$  of an elementary school teacher.

It may perhaps appear that in ering the case of the teacher too great stress speen laid upon what is relatively a small portion of those who come under a part only of the whole system. But the teacher is a crucial example; in his case the effect is cumulative, and with present changes the tendency of which he is characteristic is increasing. Turn to the secondary school, and the same trend towards highly specialised courses in science is perceptible. In the Report of the

Board of Education for 1926, in dealing with the 'xamination of grant-aided secondary schools, it s stated that while Latin holds its own and Greek shows a decrease, the number of candidates taking chemistry and physics is increasing Of the number of candidates taking the First Examination in 1926, 40.2 per cent offered chemistry and 24.7 per cent. physics. In elementary and experimental science the figure was 5.7 only, and in general science 25 In the same way, of the 437 advanced courses recognised in 309 schools, 210 were in science and mathematics, 179 in modern subjects, and 37 in classics It must not be supposed, of course, that we regard the growth of science teaching in comparison with other subjects as unsatisfactory, what we object to is the virtual limitation of science in secondary schools to chemistry and physics, or to botany in girls' schools. Science, up to the standard of the First School Examination, should be of a more cultural, and less specialised, scope: it should be science for all, and not science as preliminary training for a university course.

In training colleges where students are working towards a degree, and in secondary schools, courses are framed with a view to the requirements of a university. Indeed, in some secondary schools the work is of a sufficiently advanced character to justify representations to the university that many students under existing regulations do no more than mark time in their first year of residence. Such an organisation of courses is justifiable only in so far as the aim of the university, the training college, and the secondary school is entirely identical. The university in its science courses aims at turning out men, especially those who seek honours, who have attained a more or less high degree of specialisation. But the aim of the secondary school in framing its courses, save for the exceptionally gifted intellectually or the favoured few whose means allow, should be to turn out pupils who are fitted to take their place as citizens intellectually equipped for the average life of the community. Still more does this apply to the elementary school. A fortiori, the teachers should be fitted by their own training to educate their pupils to that end. It is by no means clear that such highly specialised courses as chemistry and physics, still less perhaps biology or physiology, framed with a view to the requirements of a still more highly specialised university course, are the best media through which school and training institution can best perform their function. With

teachers themselves trained in highly specialised courses, we are in danger of a circle as narrow in its way as that of the older type of training.

Of the importance of science in any modern system of education there can here be no question: but there is danger of a certain confusion of thought. The value of the practical application of science was fully brought out during the War, it has been apparent in many of the problems which have arisen since the War, while scientific men have repeatedly and justifiably urged upon the public and the Government the fundamental importance of the promotion of scientific research for all departments of the administration and life of the community and the British Empire. This insistence upon the value of science, aided by a confusion between instruction in science and a technical training, has obscured its true function as an element in the training of the average individual in preparation for his duties as a member of the community. Now that science enters so widely and so intimately into every department of life, especially in all questions relating to health and well-being, it is essential that both the individual who ultimately through the vote will control policy, as well as those by whom that policy will be framed and carried out, should have a general knowledge of the scope and aims of science, as well as of scientific method and the mode in which science envisages and attacks its problems. It is, however, beyond question that it should be a general knowledge on broad lines: a specialised training in some highly technical branch of science is neither needed, nor indeed is ıt desirable The educationist need feel no alarm.

As a medium of culture, the history of scientific discovery opens up to the imagination vistas of man's endeavour which place it in the front rank of humanistic studies Through a general familiarity with the methods of scientific observation and experiment in the various branches of research, may be developed a critical attitude in judgment, a power of observation, and a capacity for orderly arrangement; while a knowledge of the questions with which science as a whole is concerned in the past, present, and the future, fosters the broad outlook which, in combination with these qualities, is essential in successful dealing with the problems of life. We doubt, however, whether much of the science teaching in schools, either primary or secondary, could be regarded as science for citizenship instead of science for specialists: and we should welcome a movement which would broaden its scope and change its character.

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# Musical Stimulus and Response.

The Influence of Music on Behavior. By Prof. Charles M. Diserens. Pp. v+224. (Princeton: Princeton University Press; London: Oxford University Press, 1926.) 11s. 6d. net.

THIS book covers so wide a field that a review of it is far from easy. From the title-page we learn that it was "presented as part of the requirements for the degree of Doctor of Philosophy in the Department of Psychology of the University of Cincinnati." The last chapter perhaps provides the key to the book's construction; it consists of a report of the writer's own experiments on the subject carried out during the year 1921-22 in that University. In the conduct of this research the author must have found it necessary to acquaint himself with the accounts of previously published work; the penultimate chapter, entitled "The History of Experimental Work on Reactions to Musical Stimuli," embodies the results of his extensive reading. Having proceeded thus far, he began to collect the published material concerning the influence of music on work and on the sick, the use of music in magic and in myth, and the reactions of animals to music. These (in reverse order), together with a lengthy introduction, are the titles of the remaining six chapters of the volume.

The core of the book—the record of the author's own experiments on the physiological effects of music—is as unsatisfactory as might be anticipated from a young tyro's attempt to deal with so extremely difficult a subject. One might have felt tempted to regard these early efforts as prolegomena to more mature research to be expected from him in the future. But Dr. Diserens is now (so we learn from the title-page) assistant professor of psychology in his old University; and, more Americano, it seems only too likely that he will be fully occupied henceforth in giving lecture courses, taking practical classes, and supervising crude research work, similar to his own, conducted by future aspirants for the doctorate in philosophy.

Yet Dr. Diserens has done good service in publishing the results of his wide reading. It may be objected that the data on which he draws are of very different value—good, bad, and indifferent—and that they might well have been supplemented with more adequate criticism than is here given them. On the other hand, there is not in existence any book containing so extensive a bibliography as this on the subject. The author, therefore, deserves our gratitude alike for his attractive literary style, and for having collated the results

of previous workers, many of them from somewhat inaccessible sources, which had not previously beer brought together in one volume.

When we read Dr. Diserens' review of the long line of experiments which have been attempted to determine the influence of music on such animals as the cobra, rattlesnake, lizard, pigeon, quail, pelican, mouse, rat, hare, squirrel, antelope. elephant, lion, tiger, coyote, monkey-not to mention many others—we are struck with the lack of previous training among the investigators in the methods of experimental psychology. The experiments might have been devised by the 'man in the street,' without any attempt to distinguish between the effects of music and those, say, of strangeness of the sound, wonder as to its source, curiosity in the movements of the performer, etc. But even if these precautions had been taken, it is doubtful whether a more satisfactory result than that reached would have been attained, namely, that animals vary widely in their response, according to their species and according to the kind of music to which they are subjected.

Substitute 'individual' for 'species,' and this is precisely the result of the many, often equally uncritical, experiments that have been performed on man. All that can be said in the case both of animals and of man is that music may act as a sedative, or as an excitant, or as a stimulant to uncongenial work. Dr. Discrens shows how in primitive magic music usefully serves to enhance bodily energy and to give the magician a feeling of increased power. He brings forward evidence which indicates the semi-magical nature of many work-songs in primitive people. He also rightly \* distinguishes in such music the different functions of rhythm, melody, and words, the first eliminating, he believes, "the strain of voluntary attention," and encouraging synchronous regular movements. the second releasing reserves of energy, and the third giving relief by reference to the desires and conflicts of the worker.

"At present," Dr. Diserens concludes, "we only know that music does influence the reactions belonging to work, but we cannot as yet control such effects with such certainty as to warrant general industrial use." But here, again, the fexperiments which can be adduced have not been carried out under sufficiently stringent conditions. The data quoted in regard to the results of sorting the mail to music at the Minneapolis Post Office are not in themselves adequate to convince the trained psychologist that, as Dr. Diserens maintains, they show "that music will cause ordinary

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mail sorters to do more work and make fewer errors than usual." The influence of foreknowledge, suggestion by the investigator, and many other sources of error need to be eliminated in order to produce conviction. Nor is the author's acquaintance with modern statistical methods assuring when he concludes, from the data published by him on the effects of bicycle-racing with and without the accompaniment of music, that "the results seem to indicate a distinct stimulation of the athlete by musical stimuli."

The truth is that music exerts so many different responses—by its direct physiological effects, its arousal of imagery and association, its acceptance as purely musical meaning, as having a personified character, etc.—that different kinds of music cannot fail to produce different effects in different individuals, and that the same music may produce different effects at different times in the same individual.

This brings us to the problem—what  $\imath s$  music  $\imath$ Dr. Diserens maintains that intervals and chords do not present "genuinely musical situations," and that children and savages "delight in sound or colour combinations which pain the cultivated ear." Both these statements may be questioned, so far as the æsthetic attitude—regard for beauty—is Among the phonographic records emconcerned ployed by the author in his own experiments occur "Rosy Cheeks Fox Trot," "Dixey Medley" (banjo solo), and "Infanta March" (banjo). We wonder whether even the very highest powers of adaptation (the lack of which caused the works of Beethoven and Mozart, as well as Wagner and more modern innovators, to be characterised as unmusical when first they appeared) would enable "the cultivated ear" to designate these as æsthetically musical!

We may illustrate this difficulty by reference to the author's own experiments on the influence of music on the rate of respiration. He concludes that music, whether fast or slow, "accelerates respiration." But when we find that of the four records of 'fast' music which he uses, two—both banjo records—were disliked by three of the eight subjects and were by other subjects termed distracting, we may well ask, How, then, can we be sure that the influence of such records on respiratory rate is due to their musical character?

The whole subject—the effect of music on behaviour—needs to be attacked in a more thoroughgoing, systematic way. Yet, for the reasons already given, the psychologist is grateful to Dr. Diserens for his book.

# The Structure of Metals.

Metallographic Researches. Based on a Course of Lectures delivered in the United States in 1925. By Prof. Carl Benedicks Pp. x1+307. (New York. McGraw-Hill Book Co, Inc, London. McGraw-Hill Publishing Co, Ltd., 1926) 20s. net.

THE practice which has been developed of late years in the United States of inducing a European metallurgist of standing to give courses of lectures on his own researches at various centres is certainly an excellent one. Not only does it bring American metallurgists and students of the subject into personal touch with men who would otherwise remain nothing but names to them, but it also brings the trans-Atlantic visitor into touch with American affairs and institutions and sometimes engenders a higher degree of respect for them than had previously been entertained. Most of the lecturers thus brought to America have been British, but recently Dr. Carl Benedicks of Sweden and the German metallurgist, Dr. Guertler, have been included in the list. In the case of Dr. Benedicks, the subject matter of the lectures given has been put into book form under the title at the head of this notice.

Dr. Benedicks is of course a metallurgist and physicist of high standing, and the subject matter of his lectures accordingly attains a high level, although that level varies considerably between the different lectures reproduced in this book. Some of these-such as that dealing with the improvement of high-power photo-micrography of metals by means of the 'epiphragm'—have already been published in Great Britain, and so has much of his work on the 'homogeneous thermo-electric effect.' Another of his chapters is purely historical, and while we may understand his desire to secure recognition for a hitherto obscure Swedish metallurgist as the first observer of the Ac points in steel, this is not a matter of very wide interest. More directly important is the account of an attempt to determine the specific gravity of molten iron, an attempt which has met with a degree of success which is highly creditable when the extreme difficulties surrounding such experiments are con-

Of much more general interest are the two chapters dealing respectively with a kinetic theory of the constitution of solid matter and with the hardening of steel and other alloys. In the first of these Dr. Benedicks puts forward a kinetic theory of the space-lattice which is of essentially

physical rather than purely metallurgical interest. Indeed, it appears to have been evolved in part at least in order to account for the thermo-electric effects which the author claims to have established. It does not seem, however, that Dr. Benedicks' views really take us much forward. He objects to the suggestion that in addition to an attractive force-field surrounding an atom there should also be a repulsive field. He suggests that no repulsive field is needed to account for the properties of gases and liquids on a kinetic theory, and that its introduction in the case of solids is equally unnecessary According to this view, the atoms have no equilibrium position on a space-lattice, but merely a mean position which results from continual mutual collisions. That collision and rebound imply repulsive forces is, of course, obvious, but the suggestion is that these repulsive forces come into action only on actual contact. What, however, is really meant by 'contact' in the case of such a system as an atom is believed to be? Presumably, repulsion results from some sort of deformation produced in the atoms by their mutual forces, but it is difficult to believe that such deformation only becomes sensible at the instant when the outer electron orbits overlap or touch.

Perhaps the most interesting deduction drawn by Dr. Benedicks from his kinetic theory is that of the 'phoretic electron' mechanism of electric conduction. According to this view, electrons pass freely from atom to atom only when the outer electron orbits are in contact, and since the amplitude of atomic vibrations increases with rising temperature, there is a decrease of conductivity with rise of temperature. One difficulty of this theory, however, is that there does not appear to be any reason why this effect should not be of the same order in alloys as in pure metals, so that the low temperature coefficient of resistivity of solid solution alloys is not explained. Dr. Benedicks also attempts to explain super-conductivity at very low temperatures by the suggestion that at those temperatures the atoms become 'agglomerated,' i.e. remain in continuous contact, and therefore electrons can pass from atom to atom without resistance. This would be an excellent explanation if all metals and alloys became super-conducting when at temperatures near the absolute zero, but in fact the phenomenon is confined to a few metals only.

These somewhat important examples of the failure of Dr. Benedicks' theory suggest that it requires much further consideration before it can be seriously put forward, and it seems rather a

pity that it should have been made the subject of an educative lecture in America—at least in its present form.

Criticisms of a similarly serious nature can be brought against Dr. Benedicks' treatment of the theory of hardening of steel and other alloys. The view of the nature of hardening by the breakdown of a super-saturated solid solution and the resulting formation of finely dispersed particles of a 'precipitate' in the solid matrix is dismissed by the Swedish metallurgist on the ground of certain measurements of the electrical resistance changes in alloys during the course of hardening. It is a well-known fact that an element present in solid solution causes a far greater increase in electrical resistivity than the same substance present in the form of separate crystals. It is argued, therefore, that the breakdown of a solid solution by the formation of minute 'suspended' particles should be accompanied by a decrease in resistance. In fact, measurement shows that resistance increases up to the point where maximum hardness is attained and only then decreases.

The argument just cited, however, is based on a fallacious assumption, namely, that the resistivity of a substance A in which particles of B are suspended is independent of the dimensions of the particles. Actually, we have no experimental basis for that assumption, and there is, on the contrary, good reason to suppose that the presence of very minute suspended particles may produce a higher resistivity than the same material in atomic dispersion, in solid solution. According to the lattice distortion theory put forward by the writer some years ago, the high resistivity of a solid solution is due to the distortion of the lattice caused by the presence on it of the solute ator This also causes a certain moderate amour it hardening. But when such a composite lattice begins to break down, the first effect-which must in fact increase until all the solute at oms have begun to travel towards a state of separate aggregation—must be a partial breakdown of the parent lattice, and it is this further disturt ance of the parent lattice which will produce both mechanical and electrical hardening, i.e. increase of resistivity.

On this view, resistivity and hardness should attain their maximum at about the same stage and should then decline together, as experiment actually shows Now, what is Dr. Benedicks' alternative? He draws an interesting distinction between a 'super-cooled' and a 'super-saturated' sold solution, although it seems doubtful whether such a distinction has any real meaning. He

further suggests that, in a freshly quenched alloy or an austenitic steel, we have a super-cooled but not a super-saturated solid solution, and that agehardening in the alloys or the corresponding process in austenitic steel results from a transformation from the super-cooled to the super-saturated solution. Now it is well known that by rapid cooling and other means a super-saturated solution can be maintained without crystallisation, but it is quite another matter to suppose, as Dr. Benedicks does. that a super-saturated solution can be formed by transformation. The writer respectfully suggests that if a super-cooled solution, whether solid or liquid, is caused to undergo transformation, the result will never be the formation of a supersaturated solution, but a separation into two phases.

Somewhat similar criticism can be applied to Dr. Benedicks' remarks on hardening by cold work. This he ascribes to the production of multiple twinning, in spite of the facts that in copper and copper alloys the existence of twinned crystals confers no sign of hardness, while observation shows that twin lamellæ offer no obstacle to crystalline slip. Further, mechanical twinning is unknown in alpha-iron, yet that metal hardens vigorously under cold work. It would thus seem particularly unfortunate that Dr. Benedicks should have put before his American hearers a series of views so markedly at variance with those held by British and American metallurgists, while leaving his views open to such obvious and, in the writer's opinion, fatal objections. This is the more the pity, since Dr. Benedicks' contributions to metallurgy are so important that he should have had no difficulty in providing his audience with sound, well-established material, such as is to be found in his chapter on meteoric iron and invar, on a 'rational' section for ingots intended for coldworking, and on the 'hot wall' effect in corrosion.

W. ROSENHAIN.

# The Suppression of Mosquitoes.

Principles and Practice of Mosquito Control: being a Handbook to the British Mosquito Control Institute By John F. Marshall. Pp viii+39+20 plates. (Hayling Island, Hants.: British Mosquito Control Institute, 1927.) 2s. 6d.

ROM the British Mosquito Control Institute at Hayling Island, Hampshire, has been recently issued this handbook on the principles and practice of mosquito control, which includes also a brief account of the inception of the Institute and of the results of its work. The Institute owes

its existence to the success of an anti-mosquito campaign which was initiated at Hayling Island in 1920 to deal with the local mosquito nuisance which had become so intolerable that the inhabitants of the central residential district found it impossible to sit in their gardens in the late afternoons or in the evenings. Mr. F. W. Edwards, of the British Museum (Natural History), expressed the opinion that the trouble was probably due to the salt-marsh species Aedes (Ochlerotatus) caspius and A. (O.) detritus, and examination of some thousands of adult mosquitoes captured in the residential area during September and October proved that the latter species was almost entirely responsible. To Mr. John F. Marshall belongs the credit of beginning in 1920 investigations preliminary to the mauguration of methods of control. In April 1921, at a meeting of some seventy inhabitants, it was decided to institute a systematic campaign against the mosquitoes; committees were elected to deal with the various branches of the work, and a circular was issued to every householder on the island explaining the objects of the campaign and appealing for the assistance of voluntary workers and for financial support. A laboratory was improvised by Mr. Marshall, where mosquitoes could be examined and investigations on their breeding habits carried out.

Larvæ of Aedes detritus were found in 1921 in enormous numbers in certain accumulations of stagnating and partly salt water about a mile and a half from the centre of the residential district, and in the summer and autumn of that year several of these breeding places were permanently abolished, while a large number of others were treated with paraffin or with larvicides. During the next three years the work of abolishing or controlling the mosquito breeding areas was continued, and the nuisance progressively decreased and eventually disappeared. Evidence of this was furnished by a postcard 'canvass' of the residential district in October 1924, as well as by the fact that residents were able, for the first time in many years, to sleep out of doors. The inconvenience due to insufficient accommodation for the work in progress was severely felt, and Mr. Marshall generously erected at his own expense a separate building in which the various branches of the work could be adequately developed.

This building—the Institute—which was formally opened by Sir Ronald Ross in August 1925—contains eleven working rooms, and cost with its equipment about £4200. It is hoped that a scheme for establishing the organisation upon a permanent

basis may eventually be devised, and in preparation therefor the Institute has been incorporated. Up to the present the Institute has not received financial assistance from official bodies or local authorities—excepting a grant of £100 from the Ministry of Health in 1923 towards the cost of labour employed in certain experimental work—but has had to rely on voluntary contributions. An appeal is now issued for subscriptions—life members' and annual—and for donations to provide an annual income which will enable the work of the Institute to be carried on efficiently.

The success of the work on Hayling Island directs attention to the desirability of suppressing mosquitoes which, when present in numbers, cause general annovance by their bites, which are frequently followed by the development of sores and sometimes by even more serious consequences. These effects may be produced by Culicine as well as by Anopheline mosquitoes. This aspect of mosquito control is emphasised by the recent decision in the 'Paisley Case' (see NATURE, June 25, p. 934), the first of its kind under the Public Health Acts in Great Britain, in which the sheriff found that certain ditches had become so encumbered with silt and vegetation as to be ineffective as water courses and that the ditches and the adjacent overflowed ground had become a breeding place for large numbers of mosquitoes, and he ordained that the owners should clear the ditches and maintain them clear.

Communities which may decide or be compelled to undertake mosquito control would do well to consult this handbook for the sequence and nature of the operations and to base their methods, as at the Hayling Institute, on a true scientific foundation. For example, there are twenty-five species of mosquitoes in Britain which differ considerably in their habits, and in the period of hatching out, so that it is necessary to discover first the species which are prevalent in the district, to estimate which is the most important and should therefore be first attacked, and to see that waste of effort is avoided, for example, by treating with larvicide only the water in which larvæ have been actually observed. Useful suggestions are given for inspecting possible breeding places, for applying larvicides, for 'unstagnating' the water, and for recording progress in a central institute.

There will always be, as is pointed out in the handbook, a certain section of the public who will refuse to assist in the work of mosquito control, maintaining that the task is hopeless. This attitude of mind should be dealt with, as in the

first year or two at Hayling Island, by the education of public opinion by means of demonstrations of living and preserved specimens of the local mosquitoes and of diagrams illustrating the progress of the campaign.

The handbook is illustrated by excellent photographs prepared by Mr. Marshall, and by useful diagrams which help the reader to recognise the more important larvæ and adults. But its principal value is as a record of the means by which the serious nuisance due to mosquitoes was overcome within four years in a somewhat difficult terrain—a noteworthy achievement on which the director and his collaborators are to be warmly congratulated.

# Climatic Changes: their Causes and Influences.

(1) The Pulse of Progress · including a Sketch of Jewish History. By Ellsworth Huntington. With a Chapter on Climatic Changes, by G. C. Simpson. Pp. x+341. (New York and London: Charles Scribner's Sons, 1926.) 21s. net.

(2) Climate through the Ages: a Study of the Climatic Factors and their Variations. By
C. E. P. Brooks. Pp. 439. (London: Ernest Benn, Ltd., 1926.) 15s. net.

(1) R. ELLSWORTH HUNTINGTON, of the Geographical Department of Yale University, in a series of thirteen interesting volumes, besides numerous papers, has ingeniously and eloquently advocated the view that in the environment of which man is the creature, climate is the most powerful factor As a corollary to this view he holds that climatic changes are the main cause of the rise and fall and of the migrations of In the present work he puts his civilisation. theory in a more attractive form as he limits the climatic pulse in historic times to a comparatively narrow beat, as he explains the vicissitudes ofancient Greece by climatic influences of the order of a change of mean temperature of the year from 62° F. to 63·1° F., with a variation of humidity of 10 per cent. To determine the mean annual temperature within 1·1° F. is practicable for few countries only; and it would be impossible to prove or disprove so slight a change for any country except within recent times. That climate is an important factor in human welfare, and that people's working efficiency varies with weather, is universally recognised; and these facts are confirmed by the interesting statistics brought forward by Mr. Huntington from American industrial and

educational records. It may nevertheless be doubted whether the climatic changes in historic times have been the main factor in the migration of races and civilisations.

Mr. Ellsworth Huntington's books are always interesting, for he is graphic and collects striking examples from a wide range of evidence. His information is obviously of very unequal value, but he consoles himself with the reflection, "Perhaps your answer is wrong, never mind." Perhaps on that principle he retains the generally rejected explanation by Dr. W. H. S. Jones that the decay of Greece and Rome was due to an increase of malaria owing to a decrease in rainfall.

The new ground covered in the "Pulse of Progress" is the application of Mr. Huntington's principles to the natural history of the Jews. He has restudied the Bible and its newer criticism, and has re-written the Bible story in accordance with the geographical control of physical agents. His version is like that of the "Darkie Sunday-school":

"Bring yer sticks o' chewey gum and sit upon de floor

And I'll tell yer Bible stories dat yer never heard before."

His account of Jewish history is not likely to be reprinted in Great Britain by the Sunday School Union, but is in accordance with the general trend of advanced Biblical criticism. He points out, for example, that the plagues were the natural result of a succession of low Niles. His account, however, shows that the climate of Palestine and Egypt has been practically unchanged throughout historic times, except for the minor fluctuations that are inevitable owing to the complexity of the factors that control weather. The volume includes an interesting chapter on what Mr. Huntington describes as the suicide of Russia by the expulsion of its aristocracy and the massacre of more than a million of the more intelligent citizens. Australia he describes, on the other hand, as having "evolved a social and political system which is pre-eminent as one of the important recent contributions to human progress."

One of Mr. Huntington's most striking contributions to climatic variations within historic times has been deduced from the variations in rate of growth of the big trees of California; their evidence is complex, as different trees did not vary in the same way simultaneously, and their records require a lot of interpretation to make them tell the same tale. Their restricted distribution, as pointed out by Dr. G. C. Simpson in a weighty article reprinted by Mr. Huntington, proves that there has been no

serious change in the climate of the belt occupied by these trees during the past 2800 years. Mr. Huntington has introduced one correction on the interpretation of the big tree records, based on evidence from the Caspian. This correction is rejected by Dr. C. E. P. Brooks in (2) "Climate through the Ages," although he supports Mr. Huntington's main thesis by accepting important changes of climate within the historic period. Dr. Brooks holds that major climatic changes are due to the interaction of many geographical causes and that former glaciations and warmer periods were the result of the different distribution of land and water; but as there has been no appreciable change therein during the past 2000 years, he assigns the climatic variations during historic times to solar activity. According to his view, climate is under solar control when land and water are stationary.

Dr. Brooks compares the evidence of the big trees with the variations of the nearest salt lakes. The country in which they occur must have had a wet climate during the glacial period, which was followed by a dry warm interval, before another cold wet episode. The evidence is not altogether harmonious, for the lakes indicate a maximum rainfall at 1000 B.C. (p. 393), which was followed by a dry period until A.D. 800; according to the big trees, the wettest time was between 480 and 250 B.C., and it was followed by drought until A.D. 850. Toward the end of this time the climate was so warm that, according to Dr. Brooks, there was no perennial ice in the Arctic Ocean in the seventh century and none at all in the Greenland seas. Since then, the Norse colonies have been frozen out by increasing cold. Dr. Brooks connects this change with the end of a warm dry period in Britain in the ninth century and the final deterioration of the British climate about A.D. 1000. That the climate of Greenland has become more severe in recent times is indicated by weighty evidence; but a change of this extent in the Arctic Ocean would surely have been accompanied by greater changes in the British climate, and it is contradicted by the evidence of the Sagas. The frequent assertion that the British weather has become milder instead of more severe during the past eighteen centuries is opposed to any fundamental change in the Arctic Ocean.

The effect of geographical changes in climate naturally leads to a discussion of the Wegener theory of continental drift, which has received most support from the meteorologists; and it is interesting to note that Dr. Brooks emphatically rejects it as unnecessary.

J. W. Gregory.

# Our Bookshelf.

Condensing Plant: a Complete Treatise on the Principles and Details of Construction of Modern Steam Condensing Apparatus; for Designers, Users, and Students. By R. J. Kaula and I. V. Robinson. (The Specialists' Series.) Pp. xiii + 400. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 30s. net.

A MODERN steam power plant can be divided into three main sections the boilers and their accessories, the turbines, and the condensing plant. Most text-books on steam machinery deal partially with the three sections, but the multiplication of types of machinery in power houses and the increasing complexity of the systems tend to make specialisation desirable. Many engineers therefore will welcome this book, which is devoted entirely to the condensers, air pumps, feed pumps, and feed systems. All the earliest steam engines were condensing engines, and the patent of Savery intro-duced the practice of surface condensation. Newcomen led the injection water into the steam cylinder, and Watt made the capital improvement of a separate condenser. Of other inventors, one of the least known is Samuel Hall, whose patent for surface condensers for steam vessels, taken out in 1836, is a most interesting one. With the introduction of high-pressure steam the jet condensers gave place to surface condensers, and with the coming of the steam turbine a new chapter in the history of the condenser opened. An immense amount of investigation has been carried out on the design of condensers, the corrosion of the tubes, new forms of air pumps, and improved systems of feeding the boilers, and all these matters are admirably treated by Messrs. Kaula and Robinson in the work under notice.

Industry and the State: a Conservative View. By Robert Boothby, John de V. Loder, Harold Macmillan, Hon. Oliver Stanley. Pp. viii + 269. (London: Macmillan and Co., Ltd., 1927.) 6s. net.

This book is an interesting expression of the views held by what may be termed the left wing of the British Conservative Party. Opposed on one hand to laissez-faire as on the other to socialism. it seeks a via media between these conflicting ex-The authors are convinced that an advance in the economic status of the wage-earning classes is the necessary corollary of their advance in political status, and they seek the means whereby the improvement may be effected. Their suggestions do not partake of novelty, but they are urged with some force and ardent conviction. the planning of economic policy they would have an Economic General Staff. Industrial Councils and Wage Boards would be created with increased powers; and co-partnership would be made an essential part of industrial organisation. The writers have read widely, and there is throughout an air of attractive goodwill about their proposals. How far they are likely to attract attention is another matter. Much, for example, of the recent legislation they quote in support of their views is open to a different interpretation from what they place upon it Their account of the characteristics of industrial ownership follows that of an American, Mr. Robert Brookings; but if they had considered the arguments of Prof Henry Clay, they would have seen that most of the inferences they draw are quite misleading. Their insistence that there is an incompatibility between socialism and private property is contradicted by the work of Mr. and Mrs Webb and Mr. R H Tawney; they do not seem to grasp the distinction made by most socialists of authority between property as use and property as control. But their book is doubtless meant to be no more than a tentative sketch: and as such it is an interesting expression of a significant tendency which is not unlikely to

Engineering Metallurgy: a Textbook for Users of Metals. By Prof. Bradley Stoughton and Prof. Allison Butts. (Metallurgical Texts.) Pp. xi +441. (New York: McGraw-Hill Book Co, Inc.; London: McGraw-Hill Publishing Co, Ltd, 1926.) 20s. net.

As the range of steels and non-ferrous alloys is extended it becomes more and more necessary for the engineer to have some metallurgical knowledge, at least sufficient to enable him to make use of metallurgical literature It is becoming common to include some training in metallurgy in the university and technical college courses for engineering students, and the need for suitable text-books has arisen. The manual compiled with this object by Profs Stoughton and Butts is not quite successful in approaching the subject from the point of view of the engineer, which is distinctly different from that of the student of metallurgy. It is rather a condensed text-book of metallurgy, in which each section is treated in brief outline. without undue detail. Short sections on fuel questions, on heat losses, and on pyrometry are included, and the reader can obtain from it a general survey of metallurgical practice, from the treatment of ores to that of castings and forgings.

It is on the physical and metallographic side that the book is weakest, and there are inaccuracies on certain points, whilst the discussion of a subject of such importance to the engineer as the heat treatment of steel is very sketchy. Surely, also, since photo-micrographs are freely introduced, some short account should have been given of the use of the microscope in the engineering works. It is quite possible to make the young engineer familiar with the processes of preparing sections for microand macro-examination, and with the general characteristics of such materials as he may have occasion to use, although years of experience-may be needed before he can interpret unusual appearances in a critical manner. The authors have had to bear in mind the curriculum in American colleges, and this has no doubt restricted them in their treatment, but a different method of approach is needed in an engineering course on scientific principles.

princ

No. 3015, Vol. 120]

Handbook for Prospectors. By M. W. von Bernewitz. Pp. ix + 319. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926) 15s. net.

It may be very gravely doubted whether it is possible to write a handbook for prospectors which is of any use to the men for whom it is intended. Modern prospecting expeditions, equipped and sent out by important syndicates, are usually under the charge of trained mining geologists, who require no information upon elementary crystallography or geology. On the other hand, the rough practical prospector, who has in the past been responsible for the discovery of many of the world's most important mineral deposits, neither knows nor cares, nor wants to know anything about the "dodecahedron of the isometric system" phraseology is of quite another type. It is difficult to imagine what kind of a prospector would be benefited in the slightest degree by such drawings as the author's Fig 28, which shows a hand drill and hammer; it surely ought to be obvious that a man who does not know what these are had better leave prospecting alone; incidentally, it is probably impossible to imagine a hammer shaft worse shaped than that shown in the figure in question; it is quite certain that no practical prospector would ever attempt to use such an obviously futile appliance. Again, the detailed instructions given for such things as tying packs and arranging and priming a dynamite cartridge are surely unnecessary and can never be learnt from books. It would also be interesting to know how many prospectors the author thinks would be benefited by his table of the atomic weights of the elements as determined by the International Committee. There may be one or two things in the book, particularly in the first twenty-three pages, which may be of use to the prospector; the remainder would probably be useless to him even if he could understand it.

Monograph of the Sea-Snakes (Hydrophiidæ). By Malcolm Smith. Pp. xviii + 130 + 2 plates. (London: British Museum (Natural History), 1926) 10s.

This work in its scope and arrangement follows the lines of the British Museum Catalogues; the greater part of the text is purely systematic in nature, but the author's views on the relationships of the group and some notes on habits are included in the introduction. The list of references under each specific heading is not supposed to be exhaustive, but an attempt has been made to include all those of any importance from which the student may obtain any additional information he may require. The book will be welcomed by all systematic herpetologists as the first complete account of the Sea-snakes since the publication of Boulenger's "Catalogue of Snakes" (1896); based on the largest collection of these animals that has yet been brought together, the author's views carry weight and conviction. The most important proposed change is the recognition of two sub-families, the Laticaudinæ of Australian origin and the

Hydrophiinæ of Indo-Malayan seas; these two sub-families are established chiefly on osteological features of the skull and are regarded as two separate evolutionary lines. The author's conception of the genera agrees closely with that of Boulenger, but he finds that many of the species recognised by the latter are untenable; the names used are for the first time brought into line with the International Rules of Zoological Nomenclature.

The Theory of Equations and the Complex Variable. By Prof. Rai Charan Biswas. Pp. viii +269. (Calcutta: Chuckervertty, Chatterjee and Co., Ltd, 1926.) 3.8 rupees.

This volume contains an introduction to the theory of algebraic equations as the subject was known to mathematicians of half a century ago. It gives the usual theory of cubic and biquadratic equations, Fourier's and Sturm's methods of separating the real roots, also chapters on symmetric functions of the roots, determinants, and elimination. The only methods of numerical solution considered are those of Newton, Lagrange (by continued fractions), and Horner. Great advances in this branch of the subject have been made in the last twenty years, so the book is distinctly out-of-date on the numerical side. Its only novel feature lies in the inclusion of the equations satisfied by the sum and difference of two roots of an equation.

The author gives an account of the geometrical representation of complex numbers, with some applications to the theory of equations. Cauchy's method of locating the complex roots of an equation is explained, but the book is in no sense an introduction to the theory of a complex variable. Many of the problems are interesting, and none of them involves much theoretical difficulty.

W. Ě. H. B.

The Mind and the Film: a Treatise on the Psychological Factors in the Film. By Gerard Fort Buckle. Pp. xiv + 119. (London: George Routledge and Sons, Ltd., 1926.) 5s. net.

In "The Mind and the Film" the advance in technique in kinematography is related to the way in which a 'story' should be presented so as to secure its full psychological effect. The 'story' itself, the mode of its expression, and its angle of conception and balance, are considered in the first part of this little book; while the second part is devoted to a brief but practical discussion of the uses of photographic 'aids to the mind.' Suggestive hints, linked up with more or less obvious physiological and psychological principles, are given to the producers of films throughout; and the ordinary reader who enjoys the 'pictures' will find not a little interest in reading of the devices by which his understanding is helped, and his emotions stirred, while he follows them. The book is written in non-technical language so far as psychology is concerned, but abounds in the somewhat uncouth vocabulary of the motion picture camera.

# Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

## The Constitution of Ordinary Lead.

After repeated failures I have at last succeeded in obtaining the mass-spectrum of ordinary lead. This has been done by the use of its tetramethyl compound, a pure specimen of which was kindly supplied me by Mr. C. S. Piggot, of the Geophysical Laboratory, Washington. The vapour was first used diluted with carbon dioxide but later was admitted pure into the discharge tube. It works smoothly, but very long exposures are required. The three principal lines are 206 (4), 207 (3), 208 (7). The figures in brackets indicate roughly the relative intensities and are in good agreement with the atomic weight 207.2. This group is beautifully confirmed by its repetition 15, 30, and 45 units higher, corresponding with the mono-, di-, and trimethyl molecules. Comparator measurements show that all three of these lines are integral with those of mercury to an accuracy of 1 or 2 parts in 10,000.

There are indications that many other isotopes may be present in small proportions. An exceedingly faint line at 209 occurs in the atomic group, and on one plate is visible on the PbCH<sub>3</sub> group. This is almost certainly an isotope. Search for lighter mass numbers in the atomic group is unfortunately impossible owing to the mercury group and its penumbra. It was hoped that definite information would be available from the PbCH<sub>3</sub> group, but the unexpected appearance of lines certainly due to HgCH<sub>3</sub> complicates this region too. The evidence suggests the possibility that 203, 204, and 205 are all present in small proportion, but certain proof will only be available when mercury can be eliminated from the discharge.

The mercury lines in these experiments were more intense than any previously obtained, and indicate with certainty the presence of a seventh isotope Hg<sup>196</sup>. Comparative exposures show that this is present to the minute extent of 0.04 per cent.

F. W. ASTON.

Cavendish Laboratory, Cambridge. July 30.

## Helium Compound.

It has been shown by Paneth and his co-workers in Berlin that any element which stands in the periodic table from one to four places before a noble gas will form an easily volatile hydride; such is the case with lead and bismuth, the hydrides being gaseous at ordinary temperatures. If, as is generally supposed, orthohelium has one electron relatively far removed from the nucleus with respect to the other, it is possible that in this state the helium atom might exhibit properties similar to, though less pronounced than, those of hydrogen; that is, it might be expected to combine with such an element as bismuth, and the resulting compound would in all probability be a gas.

The point can be investigated by the use of the radioactive isotopes of lead and bismuth, and a series of experiments has been made with this object in view. The results seem to indicate that such a gaseous compound does exist. Helium and other gases, at from 0.5 to 1 mm. pressure, were passed over a strong radioactive source of radium B and radium C.

then, through a U-tube partially filled with glass wool, into a bulb containing a zinc sulphide screen; the gases could be excited in the tube surrounding the source by means of an electrodeless discharge. The relative amounts of radioactive gas formed were estimated by the number of scintillations appearing on the screen.

When a gas was circulated over the source and through the bulb, with no discharge passing, only a negligible number of seintillations was observed. With excited hydrogen a very large number appeared; it is most unlikely that these could have been due to particles of the source carried over in suspension, because similar experiments with oxygen and nitrogen gave no effect. When helium was used a radioactive gas was also found to be carried over into the bulb; the number of scintillations observed was much smaller than with hydrogen, yet much greater than that to be accounted for by hydrogen impurities in the helium or by radium emanation which had been occluded in the source. It thus seems probable that gaseous helides analogous to Paneth's hydrides can be formed.

D. M. MORRISON.

The Cavendish Laboratory, Cambridge, July 14.

# Breeding Places of Sucking-Fish in the North Atlantic.

In a note in Nature of Dec. 4, 1926, p. 805, Dr H. C. Delsman described an attempt to hatch some fish eggs from the Java Sea which, according to his investigations, belong to Echeness naucrates L. Hitherto nothing at all has been known about the propagation of this sucking-fish which is so common in tropical seas. Nor have we been any better acquainted with the breeding places and development of other sucking-fish, in spite of the attention given to these fish since early times.

Through the cruises in the years 1911-1922 of the Dana and other Danish ships in the tropical and subtropical northern Atlantic, some material has been collected that will throw a light on the breeding places of a few species of Echeneididæ. In this material we find post-larval stages (from a length of 5.6 mm) of 3 species, namely, Echeneis lineata Menzies, Remora remora Linné, and Remora clypeata Gunther (probably = R. albescens Temm. and Schl.) In the thousands of towings not more than the following numbers have been taken: about twenty specimens of R. remora, about ten specimens of E. hneata, and only one of the last-mentioned species. All these post-larval stages have been taken in pelagic tow nets, working between the surface and a depth of 25-50 metres (one of them was taken at a greater depth, but may have been caught in hauling in the implement). All the post-larvæ were caught in the months April-November, and none of them during the months of the colder season (December-March).

The post-larvæ of *R. remora* have almost all been taken in the months of June-July, and one only in September and November (the most northern and the most southern find). The catchings of *E. lineata* extend over the months of June to November, with only a single find in April. The only specimen of *R. clypeata* was caught in November. So it appears—at least as to *R. remora*—that there is a sharply limited spawning time.

The free pelagic existence of the post-larvæ is evidently of a rather short duration for these species. At a length of 3-4 cm. R. remora joins its host, and

<sup>1</sup> In Comptes rendus de l'Acad des Sci., Paris, 1926, t 182, p. 1293, I have given a short survey of these young stages as to the position and development of the sucking disc during the ontogenesis.

scarcely any more are taken freely pelagic.<sup>2</sup> At any rate, E. lineata has obtained the full efficiency of its sucking disc when it has reached a length of 5 cm. (inclusive of the long caudal fin that makes about

three-tenths of its total length).

The distribution of the post-larvæ is given on the accompanying map (Fig. 1), from which it will be seen that the two species—particularly R. remora—have chiefly been taken in the Sargasso Sea—where most of the fishing was done; very few have been taken north of 30° north latitude, and none at all have been taken in the precincts round the Caribbean islands, where the fishing chiefly was carried out during the months of November-April. The above-mentioned

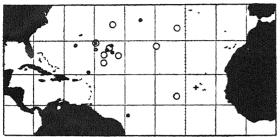


Fig. 1.—Distribution of post-larval stages of sucking-fish in the North Atlantic • Remora remora L , +, Remora clypeata Gthr , , , Echeneis lineata Menzies

species in this way appear to be typical oceanic spawning species. A very striking fact is the total absence of stages of the most common sucking-fish in the West Indies, E. naucrates L. I therefore draw the conclusion that this species, so numerous along the coasts, spawns near these in shallow water and most likely in the warmest season, at which time of the year little fishing has been undertaken by Danish ships in the West Indian seas. The correctness of this conclusion seems to be confirmed by Delsman's find in the Java Sea. In the Atlantic north of the equator we shall surely be able to find this species, particularly in the shallower parts of the Caribbean Sea in high summer.

As to the species inhabiting the Mediterranean, the spawning places, season, etc., is, so far as I know, still quite unknown.

Å. VEDEL TÄNING.

Carlsberg Laboratory, Copenhagen, June 10.

## Chromium-plating and Resistance to Corrosion.

The statement made by H. C. H. C. in Nature of July 2, p. 6, on the subject of the protection afforded by electro-deposited chromium, as mentioned in Mr. U. R. Evans's book, "The Corrosion of Metals," seems so definite that, in view of the contrary experience of several workers specialising in electro-deposition for the prevention of corrosion, it seems desirable to direct attention to the fact that, so far, preliminary tests have indicated that electro-deposited chromium cannot be looked upon as a reliable protection of iron and steel from corrosion.

Much depends on the thickness of the deposit: comparatively thin deposits have given disappointing results. Thus, a thickness of 0.0013 cm., which gives ample protection in the case of a zinc deposit and fair results with nickel, is not sufficient in the case of chromium, which rapidly breaks down in the salt-spray corrosion test; but, as I have already pointed

 $^2$  A survey of the smallest known adolescent stages of the different species has recently appeared by E. W. Gudger (Am. Mus. Novitates, Nov. 17, 1926).

out elsewhere, the hygroscopic corrosion product which is formed may have a marked influence in accelerating the corrosion. The salt spray corrosion test may, however, be taken as a particular simulation of marine conditions.

The behaviour of chromium as a corrosion preventive seems to vary, some specimens having been found to resist corrosion far better than others. The explanation is probably to be found in the inherent tendency of chromium to become passive, in which condition it presumably acts cathodically to the iron, actually accelerating the process of rusting.

Further, the statement that chromium does not adhere well when deposited directly on steel is not in accordance with the experience of most workers. On the contrary, it adheres much more readily to iron or steel than is the case when a coat of nickel is first deposited. Certainly, stripping troubles are much

more prone to occur in the latter case.

The deposition of chromium has a certain future before it on account both of its hardness and resistance to tarnish, and it is also being applied in certain special processes (for example, fine line engraving). But, so far, its use as a protection of ferrous metals from corrosion has not yet been definitely demonstrated; zinc and cadmium deposits are far superior to chromium in this respect.

S. Wernick.

Woolwich, S.E.18.

MR. WERNICK has performed a service in stating his experience on the degree of protection to be expected from electro-deposited chromium. Much of what he says is quite true, and indeed there is no disagreement between his experience and the guarded statements on this subject made by Mr. Evans in his book, and in my review of it to which he refers. Thus Mr. Evans states (page 208): "Chromium-plated articles which are now being manufactured in this country are said to withstand sea-water and tarnish"; and again, "The problem has been attended by many difficulties, some of which have not wholly been overcome as yet." In my own review I wrote, "It is stated that plated articles manufactured in this way withstand corrosion. . . ." Mr. Wernick seems to assume that Mr. Evans and I have expressed an opinion in favour of chromium more definite than is actually the case.

chromium more definite than is actually the case. It must, however, be emphasised that several workers who have tested chromium-plating have published the view that, if the plating is satisfactorily performed, it does give considerable resistance to corrosion. References to these are given in footnote No. 2, p. 208, of Mr. Evans's book. Some of them may not be entirely unprejudiced, but taken as a whole they cannot be neglected. No doubt the results, as Mr. Wernick says, are somewhat variable. This is true of any new process. In the July issue of Industrial and Engineering Chemistry, Killifer has published an article in which he definitely recommends chromium-plating as a means of combating cases of corrosion which are encountered in the chemical, oil, and paper industries. In the course of this he states that the unsatisfactory results obtained with early samples of chromium-plating were due to pin-holes.

With reference to the question of the direct deposition of chromium on steel, Ollard, who has done so much work on the question of the adhesion of many sorts of depositions, stated at the British Association in 1925 that "the best results were obtained if the steel was first coated with nickel or copper." If Mr. Wernick has obtained better adhesion by depositing chromium direct, he has achieved a considerable success, and it is to be hoped that he will publish his method in full, if he has not already done so.

So far as I have been able to ascertain, his statement

that "the salt-spray corrosion test may . as a particular simulation of marine conditions," does not command general acceptance. I have consulted Dr. Bengough, who has had wide experience of this test, and he informs me that it all depends on how it is carried out. It was introduced by the Bureau of Standards, and as carried out by them certainly did not simulate marine conditions, since the articles in question were exposed to salt spray kept permanently moist. If the test is modified so that the articles are alternately wetted with salt spray and dried at intervals, a nearer approximation to marine conditions is obtained. Salt spray, however, is not sea-water The latter contains a variety of salts and some colloidal substances. A still closer approximation is furnished by using sea-water spray with alternate wetting and drying. Even this, however, is not the same as marine conditions themselves. Dr. Bengough's view is that no artificial test of this kind which has yet been devised can really take the place of natural marine conditions.

Mr. Wernick's statement that chromium may act as a cathode against iron is very probably true. Certain chromium alloys do behave in this way. Chromium-plating is therefore comparable to nickelplating rather than to zinc-plating. The question is, is it better to plate with a cathodic material such as nickel or an anodic material such as zinc? The eathodic material will only protect if it is non-porous. Most electrolytic deposits are porous, but if they are hard the porosity can be greatly reduced by polishing. A view widely held by those with a practical experience of plating is that the protective qualities of nickel are largely connected with the fact that it can be well polished. Chromium deposits should have the same character. Anodic coverings such as zinc will protect iron even if porous, but only at the expense of the zinc. The protection will continue until the zinc is used up by the anodic corrosion. It is not difficult to understand why salt-spray tests give good results with zinc-covered articles, but it does not follow that these would have a long life in a marine atmosphere, because the rate of attack of zinc by sodium chloride solution in the presence of oxygen is very rapid, as is H. C. H. C. well known.

## A Relic of Sir Edward Frankland.

In "Sketches from the Life of Edward Frankland," printed in 1902 for private circulation (Spottiswoode and Co., 1902), and which for the greater part is his autobiography, reference is made to his apprenticeship days in Lancaster.

Frankland mentions a "delightful occupation devised to prevent my idle hands from finding some mischief still; . . . this was the making of mercurial

ointment.

"In a room on the first floor there was a very large marble or serpentine mortar, about 2 feet internal diameter. The pestle was about nine inches in diameter and one foot long, with a wooden shaft about six feet long securely fixed into it, its other end working loosely in an iron ring fixed to a beam in the ceiling. Thus the pestle could be worked round and round and backwards and forwards in the mortar.

"For the preparation of mercurial ointment, about fourteen pounds of hog's lard and five or six pounds of quicksilver were placed in this mortar and had to be triturated until a magnifying glass failed to show any globules of mercury. This blending of mercury with lard is an exceedingly tedious operation; working, in the aggregate, two full days a week, it required about three months to complete it. Moreover, the resistance to the motion of the pestle in the lard is

very great, making the labour very hard and the arms ache"

Owing to a rumour that a relic of Sir Edward Frankland might still exist in Lancaster, the writer called on the present owner of the premises at which Frankland served his apprenticeship (Mr. A. H. Robertson) and was shown the mortar and pestle situated exactly as described above, covered with

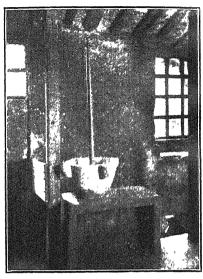


Fig. 1 —Room at Lancaster with pestle and mortar used by Sir Edward Frankland.

the dust of ages, in the semi-darkness of a small upper room where one could visualise the apprentice and his successors grinding in the true 'Mantalini' spirit of submission.

Mr. Robertson has generously presented the mortar and pestle to the Lancaster Museum, where it will shortly find a permanent home.

The accompanying photograph (Fig. 1) showing the old mortar and pestle *in situ* was taken by Mr. Wynespeare Heibert of Lancaster. W. F.

## Unusual Microstructure in Iron and Tungsten.

In the Metallurgist for June 24, 1927, page 88, F. S Tritton describes some unusual microstructures miron. One of these, originally described by Andrews in 1895, is found in pure re-melted electrolytic iron in the cast condition. The large crystals of which it is composed appear to be broken up by numerous sub-boundaries, but the etching tints indicate that these secondary grains have nearly a uniform orientation within the boundaries of the main crystal. Tritton has confirmed this by the appearance of the slip planes when the metal is strained.

Some years ago we observed a similar structure in tungsten which had been quickly cooled from the molten state. The appearance of an etched section (×200) is shown in Fig. 1 and is identical with the structure shown by Tritton. The difficulty of developing the sub-boundaries by etching is greater when the longer axis of the small grains, which have a columnar shape, is in the plane of the specimen, as in the case of iron. As the large crystals in our specimen are several millimetres in diameter, it has been possible to determine the orientation of the small grains within the boundaries of one crystal. A beam of X-rays was directed upon the polished

and etched surface of one of these crystals whilst the specimen was rocked through a small angle. diffraction pattern obtained is practically the same as that given by a true single crystal, but the spots are slightly more spread. This indicates that the small grains formed by the sub-boundaries have a



FIG 1.

nearly, but not quite, uniform orientation in each crystal.

We suggest that the sub-boundaries are formed under the influence of stresses set up during the rapid cooling of the metal. A somewhat similar break-up has been observed by us (Journal of the Institute of Metals, 107, 36; 1926) when tungsten rods are mechanically deformed by swaging
C J. SMITHELLS.

J. SMITHELLS. H. P. ROOKSBY.

Research Laboratories, General Electric Co., Ltd., Wembley.

## Dug-out Canoe in Algoa Bay.

Mr. FitzSimons, in his letter published in Nature of May 21 (vol. 119, p. 746), gives an account of a derelict canoe that was washed ashore in Algoa Bay, South Africa, in February of this year. A study of the photograph which accompanies his letter indicates that he is mistaken in attributing the canoe to the 'Mawken' or, as they are usually known in this country, the Salons of the Mergui Archipelago. The Salon canoe has a 'step' in both bow- and stern-end, and there is no trace of anything of this kind in the canoe at Algoa Bay. On the other hand, the highcurved prow, broken off short at the base, and the flat but narrow stern-end clearly indicate that the canoe originally came from the Nicobar Islands. The side blocks shown in Mr. FitzSimons's photograph are for the attachment of the thwarts, made of split bamboo, and for the support for the outrigger. In some cases the canoes are fitted with one or more short masts, which are stepped on the thwarts, but in others they have a single mast fitted with a large square sail. The canoes are steered by a paddle.

The Nicobarese travel long distances from island to island across open sea in these canoes, and I have myself seen a convoy of some eight making for one of the islands in the central group. Canoes from Car Nicobar to reach this group have to cross a stretch of some forty miles of open sea with only the small island of Batti Malv situated about half-way, and it is by no means uncommon for them to be lost at sea. If caught in the north-east monsoon such cances would be driven towards the south-west, and being caught in the Equatorial Current would be swept to the west and might easily reach the South African coast.

R. B. SEYMOUR SEWELL.

Indian Museum, Calcutta, June 21

[Mr. C. Boden Kloss, director of the Raffles Museum and Library, Singapore, also writes to suggest that the canoe came from the Nicobar Islands and should be compared with the plates opposite pp 80 and 154 of his book "In the Andamans and Nicobars" (London John Murray, 1903) - EDITOR, NATURE.]

## The Magnetic Disturbance of July 21, 1927.

In the Astronomical Column of NATURE of July 30 the suggestion is thrown out that the magnetic disturbance recorded on July 21-22 may, in the absence of any striking spot display, be attributed to an unusually active region on the sun not represented by

a spot, etc.

I submit that the following observation which I made in the late afternoon of July 15 may indeed provide this evidence. At position-angle 130°, that is, for that date near 35° latitude south-east, an immense eruptive prominence rose, splitting at about 15,000 miles altitude into a huge forked formation. each prong reaching ultimately a visible altitude of fully 220,000 miles. Of these two prongs, the more northern one dissolved fairly quickly into invisibility. whereas its southern companion endured a considerable time, showing violent fluctuations of waning and reviving brightness in portions, at varying altitudes. The apparent orifice of the stupendous eruption was fully one day's angle within the sun's disc; and if this is taken into consideration, the longitude occupied by this eruption would just be well past the central meridian on the dates when the magnetic disturbance occurred. From my notes it is also clear that the area from which the prominence rose was before then, and after, much agitated so far as the spectroscope revealed, and showed in its western front a very rough photospheric area, beset with little spots.

ALBERT ALFRED BUSS. Chorlton-cum-Hardy, Manchester.

Aug. 7.

# Fall of Temperature during the Solar Eclipse.

IT was recorded in NATURE for July 23, p. 120, that at Bangor the fall of temperature during the total solar eclipse of June 29 was not more than 0° 5 C. At Stonyhurst it is reported that no fall of temperature was observed. At Southport there was a slight fall like that at Bangor. Observations at a position on the sands opposite the northern end of the promenade gave the following result:

. 555 6.0 65 611 6.24 6.30 638 . 10°·2 10° 0 9°·8 9°·7 Totality 9°·8 10°·6 Summer Time . Temperature C.°

Thm clouds all the time intercepted the full effect of the sun's rays. J. R. ASHWORTH.

55 King Street, South, Rochdale. July 29.

# Stephen Hales: Physiologist and Botanist, 1677-1761.1

By Dr. A. E. CLARK-KENNEDY.

TEPHEN HALES was born at Bekesbourne in Kent on Sept. 17, 1677. He was admitted a pensioner of Corpus Christi College, Cambridge, in 1696 and elected a fellow in 1703. At the University he studied theology, chemistry, physics, and astronomy. In 1709 he was appointed minister of Teddington in Middlesex. Soon after, he commenced a long series of researches on the physiology of plants and animals, in which he applied his knowledge of physics and mechanics acquired at Cambridge to the problems of biology.

Hales's first scientific endeavour was to make a complete quantitative investigation of the dynamics of the circulation. "Since we are assured," he wrote, "that the animal fluids move by hydraulic and hydrostatical laws, the likeliest way therefore to succeed in our inquiries into the nature of their motions is by adapting our experiments to those laws." He therefore devised his 'hæmastatical' method, which consisted of the application of the principle of the manometer to animal physiology, and performed a vast number of vivisection experiments of great technical difficulty in the parsonage at Teddington in pre-anæsthetic days. By tying tubes into the arteries and veins of living animals, he was the first man to record bloodpressure. By counting the pulse-rate during life, and then injecting the heart with wax, he computed the circulation rate in horses, cattle, deer, and dogs, showing that in large animals the blood-flow is relatively less than in small. He estimated the actual velocity of the blood-stream in the different arteries and veins. He measured the velocity of the blood in the tissue capillaries by observation with a microscope, and compared it with indirect calculations of the velocity of the blood in those of the lungs. Studying blood-flow in the tissues, he estimated the capillary blood-pressure, and demonstrated vaso-constriction by cold, vaso-dilation by heat. Lastly, by pointing out that the heart responds to increased venous return by increased systolic output, he laid the foundation of the conception now known as 'Starling's Law.'

Hales was essentially a comparative physiologist. Observations on the physiology of plants suggested corresponding experiments on animals. Observations on animals suggested other experiments on the physiology of plants. "About twenty years since," he writes, "I made several hæmastatical experiments on dogs in order to find out the real force of the blood in the arteries: at which times I wished I could have made the like experiments to discover the force of the sap in vegetables; but despaired of ever effecting it, till by mere accident I hit upon it while I was endeavouring to stop the bleeding of an old stem of a vine which was cut too near the bleeding season, which I feared might kill it. Having tied a piece of bladder over the transverse cut of the stem, I found the force of the sap did greatly distend the bladder;

<sup>2</sup> From an address delivered at Corpus Christi College, Cambridge, on June 16.

whence I concluded, that if a long glass tube were fixed there in the same manner as I had before done to the arteries of several living animals, I should thereby obtain the real ascending force of the sap in that stem, which succeeded according to my expectation: and hence it is that I have been insensibly led on to make farther and farther researches by variety of experiments." Applying this method, he found the sap pressure in the vine in the bleeding season to be "five times greater than the force of the blood in the great crural artery of a horse; seven times greater than the force of the blood in the like artery of a dog; and eight times greater than the blood's force in the same artery of a fallow doe."

In the field of physiological botany Hales was certainly a pioneer, as he made the first proper scientific investigation of the flow of sap in plants and trees. He measured the rate of transpiration of water from unit surface area of leaves, the rate of absorption of water by unit area of root surface, and calculated the rate of flow of sap along the stem and branches. He measured the sap pressure in stems with, and in stems without, their leaves and branches. Finding that the sap pressure was upwards in all circumstances, he argued against the current theory of a circulation of the sap, and attributed its elevation to transpiration by the leaves, aided at certain seasons by a force exerted by the roots. Of this work he wrote. "I have been careful in making, and faithful in relating the results of these experiments; and wish I could be as happy in drawing the proper inferences from them." But his theory is now regarded as correct in its main essentials.

Hales also invented the present-day method of studying the growth of plants; that of marking stems and leaves at equal intervals. These experiments of his led him to perform a fundamental experiment on the growth of the bone. "As in vegetables, so doubtless in animals, the tender ductile bones of young animals are gradually increased in every part that is not hardened and ossified; but it was inconsistent with the motions of the joints to have the ends of the bones soft and ductile, as in vegetables, therefore Nature makes a wonderful provision for this at the glutinous serrated joining of the heads to the shanks of the bones; which joining, while it continues ductile, the animal grows; but when it ossifies, then the animal can no longer grow: as I was assured by the following experiment, viz, I took a half-grown chick, whose leg-bone was then two inches long; with a sharp-pointed iron, at half an inch distance, I pierced two small holes through the middle of the scaly covering of the leg and shin-bone; two months after I killed the chick, and upon laying the bone bare I found on it obscure remains of the two marks I had made at the same distance of half an inch: so that that part of the bone had not at all distended lengthwise since the time that I had marked it; notwithstanding the bone was in that

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time grown an inch more in length, which growth was mostly at the upper end of the bone, where a wonderful provision is made for its growth at the joining of its head to the shank, called by anatomists symphysis." This experiment, usually attributed to John Hunter, born in 1728, was actually performed by Hales some years before that date.

An accidental observation that bubbles of air ascended with the sap was responsible for Hales leaving the comparatively simple problem of the circulation of the blood to attack a much more difficult subject—the chemistry of respiration. Applying his 'statical method,' Hales demonstrated that plants absorb considerable quantities of 'air.' By distilling vegetable substances he showed that plants contained 'air.' He came to the conclusion that 'air' enters into the constitution of plants, and that an important function of the leaves was absorption of this form of nourishment. "It is by this amphibious property of air," he wrote, "that the main and principal operations of Nature are carried on." As Michael Foster pointed out, Hales was the first man to give a clear enunciation of the existence of gases in both a combined and a free state.

True to his comparative physiology again, from absorption of air by plants Hales turned his attention to respiration in man. Mayow had shown that animals absorb a part of the air they breathe, but Hales carried things a step further when he came to the conclusion that respiration in some way modifies the properties of the air left over so as to make it unfit for life and for combustion. Thus he was led to experiment on himself, and to perform the first re-breathing experiment. Taking a well softened bladder, and closing his nostrils, he proceeded to breathe in and out of it. "In less than half a minute," he wrote, "I found a considerable difficulty in breathing, and was forced after that to fetch my breath very fast, and at the end of the minute the suffocating uneasiness was so great that I was forced to take away the bladder from my mouth." Then in an attempt to find "some means to qualify and rebate the deadly noxious quality of these [expired] vapours," he constructed a more complicated form of rebreathing, apparatus with inspiratory and expiratory valves, so arranged that his expired air had to pass through diaphragms of cloth before being inspired again. He could rebreathe the air contained in this apparatus for one and a half minutes only when there were no diaphragms. When, however, these were moistened with a solution of 'sal tartar,' and then replaced, rebreathing could be continued for five to eight minutes. Moreover, the diaphragms increased in weight to a greater extent than he could account for by absorption of water only. If Mayow can be said to have discovered oxygen, surely Hales described carbon dioxide!

Throughout Hales's writings there is no mention of the phlogiston theory. By this silent refusal to follow Stahl, he kept alive the spark of truth that Mayow had lit, to be rekindled more than a century later by Black, Priestly, and Lavoisier If only he had followed Mayow a little more literally, and

conceived, as he had, of different kinds of gases, instead of one 'air' with variable properties, he might well have arrived at a true conception of respiration. Be this as it may, Hales's researches had a great practical outcome in his work on ventilation.

In 1740 troops lay embarked off Spithead for an expedition to America Hales suddenly conceived the notion that large ventilators would be very serviceable in making the air in ships more wholesome. These ventilators were to take the form of large bellows to be worked by hand, which would suck out the foul air from between decks. But he was not alone in this idea. A few months later, Martin Triewald, Captain of Mechanics and Military Architect to the King of Sweden, devised a similar machine. As Hales remarked, "It were indeed a very extraordinary Circumstance, that two Persons at so great a Distance from each other, without getting a Hint of it, one from the other, should happen to hit on inventing a like very useful engine." But it was even more remarkable than this, because at the same time Sutton, a coffeehouse keeper in Aldersgate Street, contrived a method of drawing off the bad air on board ship by means of the cook-house fire. Sutton's invention remained in obscurity, but Hales's ventilators at once attracted the attention of the Admiralty and they were fitted on board H.M.S. Captain, a seventygun man-of-war His ventilators, however, were received with "coolness by some, and contempt by others." But if they did not find favour at first in the Royal Navy, they met with great success in convict ships and the vessels of the slave trade. Five Nova Scotia ships were equipped with them by the Earl of Halifax. Only one slave died in the ventilated ships for every twelve in those unventilated. In a letter to Hales, Captain Thomson wrote as follows: "We found this good Effect from Ventilation, that though there were near 200 Men on board, for almost a Year, yet I landed them all well in Georgia notwithstanding they were pressed Men, and delivered me out of Gaols with Distempers upon them.'

Entering the City of London from the west, the traveller of those days must have been confronted by a curious spectacle. Newgate, the ancient gate of London, had been rebuilt with considerable magnificence. "It consisted of a carriage archway in the centre; on the side, the footpath was continued through it, which supplied a shelter for two or three old women, who fried small sausages for sale: and in the centre of it was an entry to the chief prison of the city: the mendicant prisoners for debt stood within the iron-grated door, vociferating their constant supplication for benefactions to a leathern bag which they drew in as often as it was touched: the upper chambers of the buildings constituted the prisons for felons, for whom a door was opened on the South side adjoining the old wall, and it was from this door that the malefactors were received into the cart for their last journey to Tyburn. Upon the summit was a machine for air, invented by Dr. Hales."

In 1750 a tragedy had occurred during the trial

of malefactors at the Sessions House in the Old Bailey. The Lord Mayor, two judges, and a total of sixty persons had died of the gaol distemper, communicated to them by the felons from Newgate. The aldermen of the City of London, naturally seriously alarmed, consulted Hales, and decided to install ventilators in Newgate to be worked by a windmill erected on the 'leads.' Hales's ventilators were also installed in the Savoy Prison, in the gaols at Northampton, Shrewsbury, Winchester, Maidstone, Bedford, and Avlesbury: in the London Small-pox Hospitals, and at St. George's; also in hospitals at Durham, Winchester, and Bristol, and even at Naples. Later they were introduced into the naval and military hospitals and prisons at Gosport, Portsmouth, and Plymouth So eventually even the Navy was convinced. "God be thanked," writes Hales, they are now come into general esteem for the apparent salutary good effect of them in our fleets, hospitals, etc. In the beginning of the year 1756, the Lords Commissioners of the Admiralty ordered them to be put on board the Royal George, our largest ship: in which the honourable Admiral Boscawen, taking care to have them properly worked, they were found to have the desired good effect, so to refresh the whole air in the ship, as to preserve in good health 850 men: which happy event occasioned their being ordered to be put into the whole fleet."

Wherever Hales's ventilators were installed the air in the wards is said to have been rendered much purer, and the mortality among the inmates from the gaol distemper considerably reduced. But typhus is due to lice, and not to foul air as Hales supposed. No amount of ventilation, however perfect, could have abolished the gaol distemper. Hales's bellows ventilator has gone. Hospitals and prisons are so built in these days that mechanical ventilation is seldom necessary. But his idea of the forcible propulsion of air still persists, and adequate ventilation remains one of the first principles of preventive medicine. Hales must therefore stand for all time not only a great biologist, but also one of the pioneers in public health.

It may seem remarkable that scientific work like this should have been performed by a country parson. But in the study of pure science, though he sought for mechanical explanations always, Hales found confirmation of his faith. "Nature works according to the Laws established at her first Institution," he wrote. "The farther researches we make into this admirable scene of things, the more beauty and harmony we see in them: and the stronger and clearer convictions they give us, of the being, power and wisdom of the divine Architect, who has made all things to concur with a wonderful conformity, in carrying on, by various and innumerable combinations of matter, such a circulation of causes and effects, as was necessary to the great ends of nature." Hales was an ardent parish priest. He made the women of his parish do public penance for irregular behaviour. He prevailed upon the Lord of the Manor to enlarge

the churchyard He arranged for a new parish water supply. He caused a lantern to be erected on the church tower "in which to hang a loud bell to be heard at a much greater distance, not only for the benefit of the serious and the well disposed, but also as a constant memento to the careless, the negligent, and the profane, who with the wicked m Job are but too apt to say, Who is the Almighty that we should serve him? And what profit should we have if we should pray unto him?" He also built a new aisle, and replaced the old wooden tower by a brick one. The money for these alterations was largely raised by the sale of pews, but in addition, Hales contributed £200 himself.

Of his character one of his contemporaries wrote: "He possessed a native innocence and simplicity of manners, which the characters of other men and the customs of the world could never alter; and though he often met with many unworthy objects and uncharitable offices, yet they never once lessened his natural and unwearied disposition of doing good and relieving distress. His knowledge appeared to everybody near him to feed his mind with a nourishment that gave him, in decline of life, and even in its last stages, that vigour and serenity of understanding, and clearness of ideas, which so few possess, even in the flower of manhood: and which he used often to say, he valued as the most perfect of all human pleasures There are two things in his character which particularly distinguish him from almost every other man: the first was, that his mind was so habitually bent on acquiring knowledge, that, having what he thought an abundant income, he was solicitous to avoid any farther preferment in the Church, lest his time and his attention might thereby be diverted from his other favourite and useful occupations. The other feature of his character was no less singular: he could look even upon wicked men, and those who did him unkind offices, without any emotion of particular indignation; not from want of discernment or sensibility, but he used to consider them only like those experiments, which, upon trial, he found could never be applied to any useful purpose, and which he therefore calmly and dispassionately laid aside."

Hales had been elected a fellow of the Royal Society and awarded the Copley Medal, but his reputation as a scientist was now international. In 1753 he was elected one of the eight foreign members of the Royal Academy of Sciences in Paris. Three years later war was declared with France. Hales laboured unceasingly to get Louis XV. to order the installation of ventilators into the French hospitals and prisons where British soldiers were confined. Exerting all his influence through Duhamel and the Duc de Noailles, he was at last successful, and his ventilators were installed into some at least of the French gaols, with, it is said, considerable reduction in the death-rate among the British prisoners. On this occasion the minister of Teddington was heard to say that he hoped no one would inform against

him for corresponding with the enemy!

Hales was now more than eighty years of age.

He had advanced science by fundamental experiments on the circulation of the blood, the flow of sap, the chemistry of respiration, and the growth of bone. By his work on ventilation he had established one of the first principles of preventive He had ministered faithfully to his medicine parish for more than fifty years In the last scene of his active life we see him triumphant, reducing the mortality among British prisoners exiled in the gaols of France. Thus did Hales serve science and humanity, his King and his country. "He delighted to promote the honour of his God by advancing the best welfare of man-

In this employment, blessed with serenity of temper, he calmly met his death as an acquamtance long familiarised to his mind." Stephen Hales died in 1761 in the eighty-fourth year of his age. His monument stands in Westminster Abbey, but his body hes buried under the tower which he had built himself for the church he had loved so well. There is no epitaph written on his grave, but 250 years after the birth of this great son of this College, let us adapt the words John Wesley wrote of him:

"How well did Science and Religion agree in

this man of sound understanding '"

## A National Bureau of Information.

By Dr. S. C. Bradford, The Science Library, South Kensington.

READY means of ascertaining what information has been published on any subject is of the highest importance to every worker in science and technology. As Sir Philip Cunliffe-Lister said in a foreword to the Report of Proceedings of the first Conference on Information Bureaux and Special Libraries, in 1924, "The growth of know-ledge during living memory has been remarkable and its application evident in every direction. Whilst it is generally recognised that knowledge is power, it is none the less true that a considerable proportion of accumulated knowledge is lying dormant and untapped. An immense amount of extremely valuable information is in existence, if only one knows where to find it. The volume of modern knowledge being far beyond the mental grasp of any individual, it becomes a vital necessity to provide a master-key whereby the common

storehouse may be unlocked.'

To this end much bibliographical work has been carried out. Perhaps the earliest suggestion to prepare a comprehensive catalogue of scientific papers was made to the British Association in 1855 by Prof. Henry of Washington. Afterwards, the suggestion bore fruit in the production of the "Catalogue of Scientific Papers" issued by the Royal Society from 1867 and onwards, and later, of the "International Catalogue of Scientific Literature" from 1902, which came to an end with the volume for 1914. Both these indexes covered pure science only. However, the increasing importance of science in every-day life has led to a growing demand for a comprehensive index to the printed records of both scientific and technical activity. Many applications for information or lists of books and papers on special subjects have been received at the Science Library from time to time, and recently such demands have increased in number consider-These applications have been answered so far as possible from the subject-matter catalogue of the books, monographs, and separate papers which are in the Library, and from the extensive collection of bibliographies of every kind that has been gathered together for this purpose; but the labour of preparing such lists is very considerable, and the need for a comprehensive subject-matter card-index from which the desired information could be ascertained immediately has long been realised.

An information service covering the whole field of science and technology has been in process of organisation for some years, and recently the acquisition of a very large collection of subjectmatter index-cards relating to articles and books on science and applied science, published during the period 1902-1914, together with an almost equally large collection of bibliographical slips, which require only to be mounted on cards to bring this index up to date, has placed the Science Library in possession of an exceptionally large card repertory which is now being arranged.

The Library now possesses :

1. A large and increasing collection of the scientific literature of the world, both books and periodicals, which are available for consultation in the Library or for loan to scientific institutions and research associations in Great Britain. (The catalogue of books is in the form of a card-index only, but a list of current periodicals is available, price 1s. 3d. post free.) The Library contains already more than 6000 of the scientific and technical journals recorded in the "World List" and, together with the older series and those acquired after the marking of the List, now possesses more than 7000 such periodicals, which are being added to at the rate of about 1000 periodicals annually.

2. A comprehensive subject-matter card-index to papers in scientific and technical books and periodicals, to be used as a key to recorded information and for the supply of lists of papers on given subjects. This index, which will soon include about one and a quarter million cards, is classified according to the Brussels Extension of the Dewey Decimal Classification, so that all references to information on a given subject can be found in one place under a single classification number, and this can be ascertained from the alphabetical index of subjects.

Bibliographies of special subjects are in course of preparation at very many institutions, but much of the labour expended in this work is only partially effective, because most of these bibliographies are classified on different systems, so that it is impossible to amalgamate them into a single index. To consult them, many volumes and parts must be requisitioned, each different system of classification must be mastered, and then each part of each volume must be looked through separately.

There are, however, a considerable and increasing number of bibliographies, some of them very extensive, that are classified on a single system, the Brussels Extension of the Dewey Decimal Classification. already mentioned, and, as this system is the one which has been most widely used, and is the most convenient for indexing scientific literature on a large scale and in the greatest detail, it has been adopted in the Science Library. This classification, which has been described recently (NATURE, Mar. 19. p. 429), consists essentially of two parts, (a) a more or less logical detailed arrangement of subjects, each class being given a decimal number, and (b) a copious alphabetical index of subjects from which the class numbers can be found without reference to the classification. The new edition of the "Manuel de la classification décimale" about to be published by the Imprimerie de l'Institut International de Bibliographie, Brussels, rue Piers, 101.

The index-cards are classified by writing on each of them the numbers of the corresponding subjects in the Classification, so that, when the cards are put away in their places in numerical order in the index-drawer, all the entries relating to a given subject fall together automatically. Conversely, to find what information is available on a particular subject of inquiry, it is merely necessary to ascertain the number from the alphabetical index and look at the cards bearing that number.

Practically all the available material that is classified by this system has now been gathered in

the Science Library, and it includes:

- 1. The card repertory (1902-1914) of a wellknown continental bibliographical institute that has recently ceased to operate, containing about 350,000 cards.
  - 2. Bibliographia Anatomica.
  - 3. Bibliographia Biologica. 4. Bibliographia Palæontologica.
  - 5. Bibliographia Physiologica.

Bibliographia Zoologica.

These five bibliographies comprise about four hundred thousand printed subject-matter cards from 1896 onwards, published by the Concilium Bibliographicum, Zurich; but the cards for the period 1916-1925 are being acquired gradually.

There are also the following bibliographical periodicals, which are being cut up, mounted on cards, and amalgamated with the above:

Bibliographia Geologica, 1801–1904.

- 8. Optical Society, Transactions, Index to vols. 1-25 and onwards.
- 9. Optician, Review of optical literature, 1927 and onwards.
- 10. Revue de l'Ingénieur et Index technique, published by the Brussels Institute, 1903–1925.

 Bibliographie technique, 1923–1924. Con-

12. Nederlandsch Instituut voor Documentatie en Registratuur, Meddeelingen, 1925 and onwards. 13. Le Mois Scientifique, 1911-1914, 1919.

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- 14. Technos, 1920-1924.
- 15 Koninklijk Instituut van Ingenieure, Aanwinsten van de Bibliotheck, 1925 and onwards
- 16. Nederlandsche technische wetenschappelijke Literatur, 1924 and onwards
- 17. Revue générale de l'Électricité Documentation, 1921 and onwards.
- 18. Chimie et Industrie Documentation, 1920 and onwards
- 19. Sciences administratives et les tablettes documentaires menuisibles 1925 and onwards
  - 20. Photographic Abstracts, 1927 and onwards.
- 21. Société française de Photographie, Bulletin, 1925 and onwards
- 22. Science et Industries Photographiques, 1925 and onwards.

It is intended that other important bibliographies that are not classified by this system shall be reclassified gradually, so that their entries also can be intercalated in place in the general cardindex with other references to the same subjects

This great subject-matter index will be comparatively simple to understand and rapid to use Having ascertained from the alphabetical index of subjects the number or numbers of the classes that relate to the various aspects of the subject to be investigated, all the cards bearing titles of recorded information that is pertinent will be found together in chronological order under the corresponding numbers.

By this autumn the preparation of this subjectmatter index will have advanced sufficiently for it to be made available to the public, when its extent will be approximately as follows:

Subject		No of Biblio- graphical References	Approximate Period Covered.
Mathematics Physics Geology Biology—		100,000* 15 000 48,000	1893→ 1903→ 1801–1904
General biology Palæontology Zoology Anatomy Physiology		200,000	1896→
Steam and locomotive engineers Electrical engineering. Telegraphy and telephony Motors, transmissive machin	:	39,000 61,000 2,700	·: :
machine tools, and work practice Mining and economic geology Bridges, roads, railways		45,000 30,000 33,500	:
Canals, docks Hygene, public health Water and road transport Aviation	•	10,000 11,000 19,000 4,500	1903→
Communications, transport Chemical technology Metallurgy Building construction	•	19,000 76,000 39,000 10,000	· · ·
Agriculture, economic botany, forestry Other subjects	and .	250,000* 100,000	1919 <del>-&gt;</del> 1903->
Total references .		1,112,700	

\* These sections require reclassification and therefore may not be completely arranged until some months later

For those who are unable to visit the Library, lists of books and papers will be typed from the cards so far as the general work of the Library Photostat copies of articles can also be permits. furnished on payment.

# Obituary.

Prof. Albrecht Kossel.

PHYSIOLOGICAL chemistry has suffered a severe loss by the death of Albrecht Kossel, emeritus professor of physiology in the University of Heidelberg and director of the Institute for Protein Investigation in that city. He was in his seventy-fourth year, and died after a very brief

illness on July 5

Kossel was (with Baumann and Thierfelder) one of the most distinguished pupils of Hoppe-Seyler. After being assistant to the latter at Strasbourg, he spent some years at Berlin, occupied the chair of physiology at Marburg from 1895 until 1901, and then migrated to Heidelberg. A physiologist by training and a medical graduate, he devoted his researches almost entirely to chemical subjects. both as an investigator and as editor of the Zeitschrift für physiologische Chemie for more than thirty years, he was one of the leaders in the new science of biochemistry. His earlier investigations were concerned with the nucleic acids; he recognised xanthine and hypoxanthine as among their constituents, and discovered adenine. The sugar group was detected in yeast nucleic acid (1893) and in thymus nucleic acid (1894), the pyrimidine derivative thymine was discovered in the same

Turning his attention to the simplest proteins of fish-roe, the protamines (first investigated by Miescher), Kossel recognised their high content in arginine and the other amino-acids termed by him "hexone" bases. Thus salmine was investigated in 1896, and in the same year the important aminoacid histidine was discovered by the hydrolysis of histone. Next he worked out the classical method for the quantitative separation of the hexone bases by means of phosphotungstates and silver compounds. Thus at the beginning of the century Kossel had reached a position of pre-emmence by his utilisation of the exact methods of organic chemistry, in contrast to the less precise processes

of older physiologists

Arginase, the ferment which hydrolyses arginine to urea and ornithine, provided perhaps the most physiological of Kossel's investigations, carried out in conjunction with H. D. Dakin, his distinguished English pupil. Later he discovered decarboxylated arginine (agmatine) in herring-roe, and based a most convenient method for preparing that amino acid on the use of naphthol yellow (flavianic acid).

Kossel naturally received many distinctions; in 1907 he presided over the International Congress of Physiology at Heidelberg; in 1910 he was awarded the Nobel prize for medicine. He received honorary degrees from several universities, including Edinburgh, where in 1923 he was recogmised as the leading representative from Germany at the Physiological Congress of that year. He visited London so recently as April last as a delegate to the Lister Centenary Celebrations. Many British friends will mourn his loss. Kossel leaves one son, Walther, the well-known professor of theoretical physics at Kiel, and one daughter.

The words which Kossel wrote of Hoppe-Seyler are peculiarly applicable to himself ready to acknowledge the ments of others, he could not understand attempts to import personal motives into science. . . For years he strove to secure the foundation of separate chairs of physiological or medical chemistry in German universities, in order to ensure the independent development of these subjects." Such was his character; such was his life's work.

## SIR WILLIAM ASHLEY

SIR WILLIAM ASHLEY, whose death we regret to record, was an economist of note He studied history at Oxford and afterwards went to Germany, where he came under the influence of Schmoller. which gave an impetus to most of his later work. For a period he held various university posts in the United States of America, returning to England to found the Commerce Department at the University of Birmingham, where he was professor, dean of the Faculty of Commerce, and later Vice-Principal of the University. On his retirement he settled at Canterbury and had several inquiries in hand, but these expectations were frustrated by a serious illness which terminated fatally on July 23.

Sir William Ashley was a realist in economics. He established his reputation early by his remarkable "Introduction to English Economic History." This book occupies a special place in British economic literature. While it is true that Archdeacon Cunningham had made important contributions earlier in the same field, Ashlev's work had special qualities. He emphasised the comparative treatment of economic development, and showed the general continuity of that of England with the results already arrived at by a number of German writers. The book—considering that it was written in America—may be regarded as in many respects a tour de force. It opened a new field and almost set a new standard for British investigators. Also it opens up an interesting problem. Ashley traced the development of English economic life in the Middle Ages. The effect of the centralising power of the Church was towards a uniformity of organisation and of methods in different countries. With the bursting forth of distinctive national peculiarities at the beginning of the modern period, national diversity replaced uniformity, and one wonders how Ashley's method would have dealt with England of the sixteenth and seventeenth centuries or the period of the industrial revolution-alas, one wonders vainly.

Though Ashley was primarily an economist and historian, he had a great appreciation of scientific method and scientific discovery. This showed itself in an interesting way. When he was establishing the Faculty of Commerce at Birmingham, he was greatly impressed with the idea that the student who looked forward to a career in a manufacturing industry needed not only to know the economic issues involved and the commercial technique, but also something, at least, of the main scientific ideas which lie at the root of the actual manufacturing operations, and in the conditions

of study he made provision for this

One important aspect of Ashley's work was the part he took in public affairs where economic issues were involved More than twenty years ago he took part in the Tariff Reform controversy, and since the beginning of the War he was an able and energetic member of a great number of important commissions and governmental committees Amongst these may be mentioned those on the Cost of Living and the Balfour Committee on Industry and Trade In this way during the last twenty years Ashley spent himself freely, for, as a rule, when he accepted membership of a committee, he himself undertook a considerable amount of research on aspects of the terms of reference, while he was a valuable member in initiating investigations to be carried on on behalf of the committee. He had the gift of seizing what were the central points of an inquiry and of drawing together the data that existed bearing upon them Then (as always happens in any inquiry which is worth making) there were gaps, and he was both fertile and happy in devising plans for bridging these so far as it was possible in the time available. For these reasons a great deal of Ashley's work—and that not the least valuable is known only to a few, and it is fitting that this side of his labours, as well as his better known work, W. R. Scott. should be recorded.

# Mr J. H. REYNOLDS.

Mr. John Henry Reynolds, whose death occurred on July 17 at the advanced age of eighty-five years, may be truly described as one of the great pioneers of technical education in Great Britain. Though his work was wrought chiefly in Manchester, his influence was felt throughout the whole of the United Kingdom, and even beyond the seas, and it is not too much to say that he is to be numbered among those to whose early vision and service we are indebted to-day for the great development in the teaching of technology and applied science during the past forty or fifty years. Mr. Reynolds' work began in days when the need for technical education had not been realised, save by an enlightened few, and he steadily set himself to the task of awakening interest in what he knew to be a thing of vital import to the industries of Great Britain—the provision of the highest instruction and training in science and technology for the equipment of those who are to guide and direct and, by the use of special knowledge, develop industrial work. He was in the highest sense an idealist, and in his early outlook visualised a national system of education which would afford a means of consecutive training from the elementary school to the highest work of the university for students of proved ability and application, however humble their circumstances. That he lived to see the ful-

filment in large measure of his ambitions was due, in part at least, to his own strenuous endeavours and clear vision

Mr Reynolds became secretary to the Manchester Mechanics Institution in April 1879, at a time when, to quote his own words, it "had declined in numbers and influence, and was heavily indebted financially" But under his wise administration, and with the help of generous firms and individuals, the work developed steadily, and in 1902 the present College of Technology building was opened—the direct outcome of his untiring energy, devotion, and far-sightedness through some twenty-three years In 1905 the Faculty of Technology in the University of Manchester was established in the College, and Mr Reynolds became the first dean of the Faculty When in 1912, having attained the age of seventy, he relinquished his task, the College stood as a worthy expression of his ideals and a lasting memorial of his life work, for it had become a centre of the highest type of technological education and research, with a reputation that was world wide.

Mr Reynolds' distinguished services in the cause of technical education were recognised by the Association of Technical Institutions by his election to the presidency of that body in 1913. He also took a prominent and active part in the work of numerous other educational organisations

A fearless fighter on behalf of any cause he espoused, he was yet gentle and considerate in all his dealings with others. He possessed a ready sympathy and a kindliness of heart that endeared him to all whose privilege it was to labour with him. He will be remembered by those who knew him as a man who not only cherished ideals—ideals of truth, human brotherhood, and liberty—but who sought also with untiring zeal to work out those ideals in his daily life.

J. A. Binks.

WE regret to announce the following deaths:

Prof. Alexander Backhaus, formerly professor at Gottingen and director of the Agricultural Institute of the University of Konigsberg, and from 1906 until 1913 director of the Agricultural School at Montevideo, aged sixty-one years

Mr. C. W. Daniels, formerly Director of the London

Mr. C. W. Daniels, formerly Director of the London School of Tropical Medicine and a member of the Royal Society Malaria Commission to India and Central Africa, on Aug. 6, aged sixty-five years.

Dr. Henry Mills Hurd, emeritus professor of psychiatry at the Johns Hopkins University and president in 1899 of the American Medico-Psychological Association, who was editor of the American Journal of Insanity and the Johns Hopkins Bulletin, on July 20, aged eighty-four years.

aged eighty-four years.

Prof. V. Lenher, professor of analytical and morganic chemistry in the University of Wisconsin, known for work on the chemistry of gold, tellurium, and selenium, on June 12. aged fifty three years.

selenium, on June 12, aged fifty-three years.

Dr Erwin F Smith, pathologist in charge of the laboratory of plant pathology in the U.S. Bureau of Plant Industry since 1886, and president in 1910 of the American Botanical Society, an authority on bacterial diseases of plants, on April 6, aged seventy-three years.

## News and Views.

THE Gold Medal of the African Society is awarded for pre-emment services rendered to Africa only five men have received it. The first was the late Sir Hairy Johnston, who as explorer, administrator, zoologist, and writer left a deep mark upon the continent For some years he was the president of the African Society. The second recipient was Sir Alfred Sharpe, who did splendid work as explorer and administrator in Nyasaland and Northern The medal was next given to Sir Frederick Lugard, in recognition of his great achievements in both East and West Africa Since his retirement from the Governorship of Nigeria, Sir Frederick continues to serve Africa as a member of many important committees, as chairman of the Executive Council of the International Institute of African Languages and Cultures, and as member of the Mandates Commission of the League of Nations. Sir Reginald Wingate, Bart., received the medal in acknowledgment of his great career in the Sudan. Now the medal has been given most fitly to Sir Ronald Ross. By this act the African Society pays homage, not only to Sir Ronald personally, but also to all who by their researches into the problems of health in the tropics have wrought such beneficent changes in the conditions of life in Africa.

A PUBLIC appeal for £35,000 for the purchase of 1444 acres of land on Salisbury Plain adjoining Stonehenge has been issued by a Stonehenge Protection Committee with the support of the Prime Minister, Mr. Ramsay Macdonald, Lord Crawford and Balcarres (president of the Society of Antiquaries). Lord Grey of Falloden (vice-president of the National Trust), and Lord Radnor (Lord Lieutenant of Wiltshire). The land upon which options have been secured includes the whole 'sky-line' of Stonehenge and covers the area upon which are situated the huge aerodrome and the huts which now disfigure the site and dwarf the monument If the purchase is effected. these will be cleared away and the land vested in the When it has been added to the National Trust actual site of the monument, which was presented to the nation nine years ago by Sir Cecil Chubb, building in the neighbourhood of the monument or the undue encroachment of the plough will be effectually prevented.

The disfigurement of the Stonehenge area has been made imminent by the development of motor traffic and the increase of the number of tourists visiting Salisbury Plain. Extensive plans for building, indeed, are already in existence. On more than one occasion in recent years, it will be remembered that those who are interested in the protection of the surroundings of the monument from anything that would detract from its unique character and dignity have been alarmed seriously by the nature of proposals for the development of this part of the Plain. That it should be placed beyond the reach of such risks is a matter of even more than national concern. It may confidently be hoped that the

appeal will receive the strong support it deserves. Contributions should be made to the National Trust (Stonehenge Fund) and addressed to the Secretary, 7 Buckingham Palace Gardens, London, S.W.1.

The ether is becoming seriously overcrowded with radio waves. Two or more stations having nearly the same official frequency often 'jam' one another in an ordinary receiving set. The problem of inventing a simple method of cutting out the interfering stations is therefore one of great importance to the radio engineer. In a paper read by G. G. Blake to the Radio Society of Great Britain on May 25, a description is given of a method of improving the selectivity of a receiving set by means of ordinary sound resonators. The results obtained were most encouraging Even when several stations were working with considerable mutual interference and bad atmospheries were present, it was found possible to isolate the selected station by means of a sound resonator. It is concluded that there is no reason why many more frequencies could not be selected for stations in the wave bands at present employed for broadcasting. The author suggests that by the use of a hot wire microphone and a number of sound resonators each tuned to a different station, all the signals could be heard or recorded simultaneously. He points out that the hot wire microphone or thermotelephone receiver was described by Sir William Preece to the Royal Society in 1880. It consists of a tightly stretched fine platinum wire fixed at one end and attached at its other extremity to the centre of a diaphragm. The wire is heated by a current from a battery and the expansion or contraction of a wire in response to words spoken towards a microphone in series with it cause the diaphragm to vibrate.

In his presidential address to the Devonshire Association for the Advancement of Science, Literature and Art, delivered on July 19, Mr. W. C Dampier Whetham took as his subject "The Newtonian Epoch, 1685-1920" Mr. Whetham sums up as the two most important consequences of Newton's labours, the establishment of the validity of terrestrial mechanics in celestial spaces, and the removal of philosophical dogma from the basis of natural science rational outlook was carried over into chemistry by Lavoisier and formed the basis of the work of Dalton. Joule, Kelvin, Darwin, Young, Clerk Maxwell, etc., in the nineteenth century. The discovery of Neptune gave final proof to Newton's theory, and the science of spectrum analysis extended terrestrial chemistry to the heavenly bodies. Towards the end of the nineteenth century a new era began with the discovery of X-rays, electrons, radio-activity and atomic disintegration. The distribution of energy in the radiation from a hot body led to Planck's quantum theory, and this was used by Niels Bohr for the construction of a new and brilliant theory of the atom. Concurrently a new view of the ether developed, giving rise to the revolutionary outlook on space and time put forward by Einstein in 1905. This was summed up by Minkowski in the conception of a space-time interval, which, with the principle of equivalence, gave in the hands of Einstein the relativity theory of gravitation. In the two directions of the quantum theory and the theory of relativity, physics seems to be breaking away from the dynamics of Newton. "The new vision of Nature is utterly unlike the materialistic nightmare which afflicted some who suffered from ill-digested Newtonian philosophy. We must hope that a future Newton may reconcile the discrepancies, and bring the laws of these new phenomena into subjection to the human mind."

THE fourth International Congress of Theoretical and Applied Limnology will be held in Rome this year, and a full programme has been arranged covering the period from Sept 18 to Oct 3. The congress will be divided into four sections, dealing with physics and chemistry, geology and hydrography, biology, and applied limnology, respectively The first week will be spent in Rome, during which time lectures and papers will be given and opportunity will be afforded for visiting the Limnological Exhibition, the Royal Central Laboratory of Hydrobiology, the Royal Fish Breeding Establishment, and the Zoological Gardens. Receptions will also be given on the Capitol and at the Royal Italian Geographical Society. The remainder of the programme offers some very enjoyable excursions. Two days will be spent at Naples, where the visitors will be received at the Zoological Station and at the University. The congress will conclude with a most attractive itinerary to the Hydrobiological Stations situated amongst the delightful scenery of Lakes Garda, Como, and Maggiore, while nights can be spent en route at Perugia, Verona, and Milan. The congress will end on Monday, Oct. 3, at Lake Maggiore. Members of the congress on payment of the sum of 50 L. will be entitled to reductions on the Italian railways, and to cards of admission to all the meetings and excursions. They may be accompanied by members of their families for a fee of 30 L. All communications and inquiries relative to the congress are to be addressed to the Segretaria del Comitato Esecutivo at the R. Laboratorio Centrale di Idrobiologia, piazza Borghese 91, Roma (9).

By an Order of the Committee of Privy Council, Sir Hugh K. Anderson (Master of Gonville and Carus College, Cambridge) and Prof. T. R. Elliott (Director of the Medical Unit, University College Hospital, London) are appointed members of the Medical Research Council into the vacancies caused by the retirement of Sir Frederick Andrewes and Sir Cuthbert Wallace.

On Aug. 8 Prof. Henry Fairfield Osborn completed his seventieth year. The event has given his many friends the opportunity to present him with a Queen Anne cup of beautiful design and an illuminated manuscript with their greetings and signatures. At a reception to be held later, the surplus of the fund subscribed will be presented to Prof. Osborn for the advancement of his research work. We offer congratulations on the successful labours of the past and best wishes for the future.

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From a notice just issued by the Ministry of Agriculture and Fisheries, we learn that in accordance with a recommendation of last year's Imperial Conference, an Imperial Agricultural Conference will be held in October next. It may be recalled that the Imperial Conference laid great stress on the potential value of co-ordination between the research agencies in various parts of the British Empire. Many will be interested to see what concrete shape co-ordination will take. There is as yet little co-ordination within Great Britain, though the need for it positively glares at one from the pages of a recent publication by the Ministry, "Research and the Land." In the words of the adage, "charity begins at home."

The Washington Science Service Daily News Bulletin contains a brief comparison of the ancestry of present-day American statesmen with that of statesmen in Revolutionary times. It is found that the law-making of the United States is still chiefly in the hands of 'Nordies' as it was in Revolutionary days. Mr. Frank L. Babbott finds that 90 per cent. of the statesmen who met in Philadelphia to frame the constitution were English, Scotch, or Irish, while in the last Senate 81 per cent. were of similar descent, although the numbers are about twice as great. Of the others, several were partly and two wholly of French origin, two were Swedish, and one Norwegian.

THE series of observations of the sound of the firing of heavy guns at Shoeburyness, to which reference was made in Nature of July 23, was continued on Aug. 3, when ten rounds were fired. The time of firing of each round was broadcast by the B.B.C. from Daventry. So far, reports have been received from sixteen observers, of whom five only heard the sounds. Of these five, four were located on the east coast, from Clacton to Ipswich, and the fifth was located at Isleworth. Four observers in London and seven observers distributed over a wide area, state that they failed to identify the sounds of firing. The reports so far received are not sufficient to define with accuracy the zones of audibility. Instrumental observations were obtained at the Universities of Birmingham and Bristol. At Birmingham the records showed that the time of transit of the sound waves from the gun to the instruments averaged about 12 min., compared with the time of transit of 11 mm. 51 sec. on July 9, and 12 mm. 16 sec. on July 13.

From time to time interesting accounts of the lives of the earlier American chemists are published by Dr. E. F. Smith, of the University of Pennsylvania, and one of his recent sketches concerns James Blythe Rogers (1802–1852), the eldest son of Dr. P. K. Rogers, an apothecary of Baltimore The latter became professor of chemistry at the William and Mary College, and it was at this college that J. B. Rogers and his three brothers, William, Henry, and Robert, all men of science, were educated. After a brilliant college career James studied medicine, and received his doctor's degree from the University of Maryland in 1822. He was not pleased with his profession, however, and so he became the superintendent of an

extensive chemical factory in Baltimore Father and sons were in regular correspondence, and the many quotations which are taken from their letters are very illuminating. Each became eminent in his particular branch of science. James being well known as a competent analyst. He did most of his work in connexion with the geological surveys carried out by his brothers William and Henry The chemical factory with which he was at one time associated derived great benefit from his labours, as he was ever ready to apply his knowledge to industrial purposes.

THE Report of the Fuel Research Board for 1926 (H.M S.O. 1s. 3d. net, pp. 62) reveals how well based is the research into the fuel resources of Great Britain which has been developed in the last few years. This work is carried on not only at the Government station but also at various university and other institutions, where independent workers receive assistance from State funds Much of what is contained in the Report has been published elsewhere, but some information is new. An apparatus devised for determining the reactivity of coke is described Perhaps the section dealing with coal treatment by carbonisation at low temperatures and by hydrogenation will be read with most general interest. The opinions as to commercial success attained by such processes are guarded but hopeful. A welcome feature is the announcement of an arrangement whereby the Gas Light and Coke Co. undertakes to operate a setting of the cast-iron vertical retorts devised at Greenwich under the commercial conditions of a modern gasworks for a period of years. Such an arrangement ensures for the process a commercial trial under the most favourable economic conditions, but nevertheless a searching trial alongside carbonisation plant which must and does pay its way. Hydrogenation of coal is regarded as still more immature from a commercial viewpoint, but it is pointed out that even if the process cannot compete with imported natural his at present prices, conditions may change at any time. It is of great importance that information should be available of any process for producing liquid fuels from home sources. No one can read the Report without feeling reassured as to the measure of scientific effort in Great Britain to make the best use of native fuels.

Part I. (Medical) of the Registrar-General's statistical review for 1926 of Great Britain has recently been issued (London · H.M. Stationery Office. 15s.). From this it appears that the birthrate for the year 1926 was 17 8 per 1000 population. Excepting the rate of 17·7 in 1918, the last year of the War, which at that time was regarded as phenomenally low, that for 1926 is the lowest recorded since the establishment of civil registration in Great Britain. In view of the continued decline during the first half of the current year it is probable that the rate for 1927 will be lower than that for 1918 The crude death-rate was 11 6 per 1000 population, and was equal to that of 1923, the lowest on record. In 1924 and in 1925 the rate was 12·2 per 1000. The pro-

visional birth- and death-rates and infantile mortality in 1926 for some other countries were as follows:

	Birth- rate	Death- rate	Natural Increase	Intantile Wortality
Sweden . England and V Switzerland (1 France Belgium Germany Norway . U.S.A . Scotland Holland Hungary . Italy (1925)	16 9 17 8 18 4 18 8 19 0 19 5 19 7 20 1 20 9 23 8 26 7 27 8	11.8 11.6 12.2 17.5 12.9 11.7 10.6 12.1 13.0 9.8 16.5 16.8	5 1 6·2 6 2 1 3 6 1 7 8 9 1 8·0 7 9 14·0 10 2 11 0	70  98  101  73 83 61 168 119

Thus, the birth-rate in England and Wales has now fallen below that of France, and with the exception of that of Sweden, is the lowest of the principal European countries. On the other hand, the general death-rate and the infantile mortality are low compared with the rates prevailing in most of the other countries

THE Pathological and Bacteriological Laboratory Assistants' Association is holding a conference at Cambridge from Aug. 22-26, under the presidency of Prof. H. R Dean. A scientific programme has been arranged for each morning, whilst the afternoons will be reserved for excursions. The conference will be opened by the Vice-Chancellor of the University, the Rev. G. A Weekes, at 10.30 A.M. on Monday, Aug. 22, and the opening ceremony will be followed by a lecture on Cambridge, by the Vice-president, Mr. W. A. Mitchell: in the afternoon the Association will be entertained in the Fellows' Garden, Downing College. On the four following mornings, papers and demonstrations will be given in the Department of Pathology of the University. These cover a wide range of subjects, among which the following may be noted: a standard dietary for laboratory rabbits and gumea-pigs, by E Pleasance; the manufacture of smallpox vaccine as carried out in the laboratories of the Shanghai Municipal Council, by A. E. P. Grimmo; cinema films of infusoria. spirochætes, trypanosomes, etc., by G Harper; virulence tests in the identification of B. diphtheriæ, by S. J. Denyer; the preparation of plague vaccine, by F Leeson; difficulties encountered in the differentiation of paratyphosus A, B, and C, by S. J. Denyer; tissue cultivation technique and pulsating heart cultures, by V. C. Norfield, the cultivation of protozoa, by W. Cooper and W. J. Muggleton. This selection from the list of papers and demonstrations on the programme gives a good idea of the standard of knowledge and technique required of a modern laboratory assistant. The Conference dinner will be held in the hall of Trinity Hall on Thursday, Aug. 25, and during the evening the Woodhead Medal will be presented to Prof. J. Lorrain Smith. The meeting concludes with demonstrations on the morning of Friday, Aug. 26.

THE annual report by the Conservator, Sir Arthur Kerth, on the Museum of the Royal College of Surgeons of England has recently been issued. The Conservator has reported on many discoveries of human remains, and several of the skulls have been added to the Museum. The odontological collection is once more on view, after extension of the room, with many additions. The pathological, osteological, teratological, and physiological collections have received numerous additions, many old specimens have been re-mounted, and some re-cataloguing has been undertaken. A valuable collection of books relating to the history of surgical instruments has been presented by Mr. J. Barry Hopkins Several pieces of research work have been carried out in the Museum, eg one on the lymphatic system of fishes by Mr R. H. Burne. The Conservator acknowledges the assistance he has received from the sectional curators and voluntary helpers.

The International Hydrographic Bureau at Monaco has issued as *Special Publication* No. 18 a list of litesaving stations of the world with their equipment and exact geographical positions. It has been compiled from Sailing Directories and other official documents. The text is in both English and French. When notice of errors, omissions, and changes are received, the Bureau will issue a corrected list and hopes to arrange for a translation into all maritime languages. The list should prove valuable to ship masters, marine insurance companies, steamship companies, and others. Its price is 30 cents.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in mechanical engineering in Swansea Municipal Technical College—The Director of Education, Dynevor

Place, Swansea (Aug. 20). An inspector of weights and measures and two qualified assistants to the Chief Inspector of Weights and Measures of the Weights and Measures Department of the Essex County Council-The Clerk of the County Council, Shire Hall, Chelmsford (Aug. 22). A Statistical Director of the Cotton Trade Statistical Bureau now being established by the Manchester Chamber of Commerce—The President of the Manchester Chamber of Commerce, Manchester (Aug. 24) An assistant lecturer on machine design in the University of Birmingham - The Secretary, The University, Birmingham A lecturer in agricultural chemistry in (Aug. 24). the University of Reading—The Registrar, The University, Reading (Aug. 26). A professor of anatomy in the University of Durham College of Medicine-The Registrar, University of Durham College of Medicine, Newcastle-upon-Tyne (Aug. 31) A lecturer in biochemistry in the Physiological Department of the University of Birmingham—The Secretary, The Univer-A senior lecturer in sity, Birmingham (Sept. 21) physiology in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (Sept. 26). A senior demonstrator in the Department of Physiology of the University of Otago, Dunedin, New Zealand-The Registrar, University of Otago, Dunedin, New Zealand (Oct-20). An agricultural economist in the Agricultural Department of the Tanganyika Territory—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Steet, S.W.1 (Nov. 1). An assistant inspector of plants and produce in the Lands and Forests Department of Sierra Leone—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/15528).

## Our Astronomical Column.

COMET NOTES.—Miss J M Vinter-Hansen has computed the following orbit of Reid's Comet (1926 VII.=1927 b) from observations made at the Cape Observatory on Jan 26, Feb. 3 and 8 (Copenhagen Circ., 159):

$$\begin{array}{cccc} \mathbf{T} & 1926 \ \mathrm{Dec.} \ 30\cdot676 \ \mathrm{U.T.} \\ & \omega & 225^{\circ} & 5 \ 48' \\ & \Omega & 108 & 50 \ 96 \\ & \imath & 83 & 39\cdot69 \\ \end{array} \right) 1927 \ 0 \\ \log q & 9 \ 87818 \\ \mathrm{O-C} & \begin{cases} \Delta \lambda_2 \cos \beta_2 = +0\cdot52' \\ \Delta \beta_2 & = -0\cdot08 \\ \end{cases}$$

The large residual in the middle place suggests possible departure from a parabola. The comet may still be observable: the following ephemeris for 0<sup>h</sup> is by A. V. Nielsen from the above orbit:

		R.A.		NI	Decl.	
Aug. 16.	$7^{\rm h}$	43m	$2^{s}$	13°	6′	
24.	7	49	4	13	17	
Sept. 1.	7	54	32	13	28	
9.	7	59	22	13	39	
17.	8	3	32	13	51	
25.	8	6	57	14	4	
Estimated magnitude, 14.						

EPHEMERIS OF STEARNS'S COMET (1927 d) BY H. THIELE.

Aug.	19. 23.		R.A. 11m	448	N Decl 24° 39′
	Z3.	14	14	8	24 39

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		RA		N. 1	Decl.
Aug. 27.	14	16	42	24	39
31.	14	19	26	$^{24}$	38
Sept. 4.	14	22	19	24	38
8.	14	25	21	24	38
12	14	$^{28}$	31	24	38

Observations of Blathwayt's Comet, 1927 a = 1927 II., made at the Cape Observatory between Jan. 17 and Mar. 29, have been sent to the I.A.U. Bureau at Copenhagen; from these Miss J. M. Vinter-Hansen has deduced the following parabolic orbit (Copenhagen Circ., 160).

EPHEMERIS FOR 0h

	$\mathbf{R} \mathbf{A}$	S Decl
Aug 8.	3h 13m 55s	8° 39′
16.	3 8 15	8 47
24.	3 0 47	9 2
Sept. 1.	2 51 31	9 19

Estimated magnitude. 12

# Research Items.

THE ROCK SHELTER OF LA GENIÈRE -MM C. Gaillard, Pissot, and C. Cote describe in L'Anthropologie, T 37, Nos. 1-2, the results of an exploration of the rock-shelter at Serrières-Sur-Ain, one of a number of rock-shelters and grottoes on the Ain examined in 1903, in which the traces of occupation then discovered were attributed to the early neolithic. Beneath the level opened up in 1903 has now been found the evidence of an earlier period which the authors assign to the end of the Magdalenian. This level of occupation has produced a relatively small number of animal remains, including Bison priscus, Cervus tarandus, species of goat, ox, and pig, and Canis vulpes, a human skull—of a child—and a large number of examples of a microlithic industry in which sub-triangular forms are numerous Of bone points, four only were discovered. An engraving of a reindeer and another of a bison present a very close analogy with the paintings of the Font du Gaume The australoid or negroid characters of the skull suggest that this is a race of late Magdalenian date descended from the Grimaldi people and the culture a specialisation of Magdalenian rather than Azilo-Tardenoisian. It is possible that this same race was responsible for the art of the Font du Gaume, and it is suggested as probable that its culture is to be attributed to a strong infiltration of the Capsian of North Africa.

THE INHERITANCE FACTOR IN PNEUMONIA -An interesting study of a family which is subject to pneumonia and other respiratory diseases has been made by Prof. Raymond Pearl (Annals of Eugenics, vol. 2, p. 1) It is usually assumed by medical clinicians that pneumonia is merely the result of a chance bacterial infection, but here is a working family living under fairly good conditions and showing a far higher incidence of pneumonia than their neighbours or others living in similar conditions. Every child in this family of thirteen had had pneumonia, one having had it twice and one three times, and seven had died of it. They could not have im-mediately infected each other because of the time intervals between attacks. By a careful study of the pedigrees of father and mother, Prof. Pearl shows that the father's family stock had a high incidence of tuberculosis, fertility somewhat above the average, and respiratory diseases in childhood; while the mother's family showed low fertility and very low infant mortality. The evidence as a whole points strongly to an inherited constitutional condition as the cause of the very high incidence of pneumonia in this family. The same probably applies to bacterial diseases generally, some individuals and families mheriting greater susceptibility than others. But the nature of these differences in power of resistance to a specific bacterium and the manner of its inheritance are as yet very inadequately known. Further knowledge should make a genetic analysis possible, as has been done with susceptible and resistant strains of certain cultivated plants.

Plague in South African Institute for Medical Research (Publication No. 20, vol. 3, pp. 85-256) has recently been issued dealing with the plague problem in South Africa. Dr. Harvey Pirrie contributes notes on veld rodents susceptible to plague, illustrated with eight plates, and on plague infection among these rodents. A hitherto undescribed bacterial disease has been found in the gerbille. Experiments have also been carried out with vaccines, sera, etc., on the prophylaxis and treatment of plague. Dr. Ingram discusses plague

investigation from an entomological aspect, and Dr. Alexander Mitchell contributes a historical summary on plague in South Africa

AGRICULTURE IN INDIA.—Dr. Clouston, in a "Review of Agricultural Operations in India, 1925-26, surveys in detail the conditions throughout the country, and includes reports and statistics on a number of crops, soil investigations, animal nutrition and vetermary science, engineering, insect pests and plant diseases, together with a list of the agricultural publications during the year (Calcutta: Government of India Central Publications Branch. 2.6 rupees; 4s. 3d.). On the whole, in spite of an uneven distribution of rain, the season was fairly good. Much progress has been made in the seed selection and hybridisation of rice and wheat, and the particular importance of phosphate manuring for the former crop in dry seasons established. Considerable organisation and legislation has been necessary in the case of cotton, but experimental work, such as spinning tests at the new technological laboratory and the development of a fumigation scheme for use on imported cotton, has been successfully carried out. Important advances have also been made in the technique of breeding sugar-cane, and improved methods of cultivation and manuring are yielding good results. Research on fundamental soil problems is being carried out by the various agricultural departments The soil in general is very deficient in nitrogen owing to prolonged cultivation without the addition of manure. Organic materials, such as cattle or green manures, are the most suitable, much that could be used with advantage being at present exported. Economical modifications of the original method of making artificial farm-yard manure have already been devised. A new line of work, which is yielding interesting practical results, is the determination of the feeding properties of pasture grasses and the relative value of Indian fodders. The serious rinderpest disease of cattle has been effectively diminished by the widespread use of preventive inoculation, but the loss incurred during the year under review was extremely serious, and further investigations with the view of conferring permanent immunity are being undertaken. The co-operative movement started by the Government in 1904 is now working in touch with the agricultural departments, but further extension is still needed as, for example, in the organisation of the marketing of produce. Useful work in this direction has been done by the cotton-sale societies in Bombay and the milk societies m Bengal.

Petrified Forests.—In the June issue of the Scientific Monthly Miss Winifred Goldring, of the New York State Museum, describes the oldest known petrified forest, located near the village of Gilboa in the Catskill Mountains. The first discoveries were made in 1869, but it was not until 1920 and the succeeding years that material was brought to light in sufficient quantity to enable the nature and extent of the forests to be reasonably determined. The fossils belong to the Upper Devonian horizon. During this period the Catskill Mountains formed the low shore-line of a shallow sea. At the present time the fossil trees are found on three distinct levels, indicating that the swampy shore-line was very unstable. Gradual submergence of the coast carried the trees beneath the water and sediment piled over their trunks. When the deposits accumulated the forest again crept down to the water edge. Evidence shows that three successive forests flourished here, were

submerged and buried. These Gilboa trees in general appearance must have resembled the tree ferns of the tropics at the present day. They were, however, seed ferns or Pteridosperms, standing in a position between the tree ferns and the higher seed plants. A new genus, Eospermatopteris, has been created for the Gilboa forms, and two species, E. textilis (Dawson) and E. erianus (Dawson), have been distinguished The outer part of the cortex of the stem is the only part of the structure to any extent preserved, the interior parts having been washed out and the structunes filled with sand. The cortex consists of interlacing strands of sclerenchymatous tissue, and the outer surface is marked with shallow ridges and furrows, in some cases giving the effect of a bark. These trees were probably 25 ft. to 40 ft. high and bore fronds from 6 ft. to 9 ft. in length, on the dichotomous tips of some of which were borne the seeds The bulbous stem bases were undoubtedly buried in the swamp mud as the roots were not heavy, and otherwise the trees would have had no adequate support. Foliage was light and much looser than in the tree ferns of to-day. The lycopod-like trees (Protolepidodendron) also grew in small numbers in the

VERTICAL DISTRIBUTION OF PLANKTON.—Mr. F. S. Russell (Biological Reviews, vol. 2, No. 3, pp. 213-262, 1927), in a very able and exhaustive article, reviews the present position of the problem of the vertical distribution of planktonic organisms begins by surveying the possible controlling factors in the vertical distribution of plankton, such as light, temperature, winds and currents, pressure, salinity, chemical constitution of the sea water, and so on. The author next summarises the known facts of the vertical distribution of planktonic organisms themselves, and concludes that each plankton animal has its own vertical zone, varying for each species and for individuals of different ages and stages of development, and even for different sexes. The type of distribution for any one species may vary from place to place, season to season, and day to day. In fairly homogeneous waters, light intensity may be the prime factor governing vertical distribution, though other factors such as temperature and salinity, rate of movement, and distribution of food must not be ignored. The author then deals with the results obtained by experimental work on planktonic organisms in order to discover how far the observations in the field are borne out and supplemented in the laboratory. He rightly points out that field work should always precede laboratory experiment in order that a proper interpretation of laboratory actions should be possible. In the closing section of the article the author discusses mainly the evidence that light is the most important controlling factor in the vertical distribution of marine planktonic animals. The article concludes with an exhaustive bibliography.

GENETICS OF POLLEN TUBES.—A new gene mutation of Datura Stramonium called tricarpel is being studied by Drs. Buchholz and Blakeslee (Proc. U.S. Nat. Acad. Sci., vol. 13, p. 243). By making various crosses between tricarpel and normal and studying the pollen tubes as they grow down the style, it is found that the factor for tricarpel suffers a considerable amount of elimination through slower growth and also through bursting of the pollen tubes as they pass down the style. The latter process occurs more frequently in pollen tubes of the tricarpel type. When this type is self pollinated, more than half the pollen tubes are abnormal in appearance, and the rate of growth of the normal pollen tubes is slower, although the percentage of pollen germination is

essentially the same as in the type. This gametophytic selection is believed to be an important evolutionary factor. Pollen tube growth has also been studied in the transcription self-sterile plant, Lythrum salicaria, by Mr. D. Kostoff (l.c., p. 253). It is found that germination takes place equally well in all pollinations, but that the rate of growther of the pollen tubes is much retarded by 'illegitimate' pollination, i.e. by putting the wrong kind of pollen on a particular stigma. With 'legitimate' pollination the curve of growth of the tubes is symmetrical, with decided acceleration in the later stages. It has already been shown in self-sterile tobacco that in moompatible matings the pollen tube growth is so slow that the flower falls before the pollen tubes reach the ovary

THE PHYSIOLOGY OF FRUIT TREES.—Two points of general interest emerge particularly from Dr. T. Swarbrick's first paper, under this general title, which is published in the Journal of Pomology and Horti-cultural Science, vol. 6, No. 2, June 1927. His own observations, as also his extensive citation from the literature, make it clear that there is a very interesting phenomenon presented by the temporary disappearance of starch from the phloem of broad-leaved trees, which takes place early in the spring. Usually this is ascribed to a fall of temperature, but Dr. Swarbrick directs attention to Prof. Chandler's warning that the same phenomenon is reported from the genial Califorman spring climate as from the fruit trees of the regions, with hard winters, in the east of the United States. Similarly, Dr. Swarbrick found in one- to fiveyear-old apple branches at Long Ashton, near Bristol, a disappearance of starch from the cortex and phloem in the middle of January, followed by its reappearance at the end of March Dr. Swarbrick also reports that the formation of new xylem from the cambium in the spring begins at the distal end of the apple shoots in the spring, its commencement being associated with the position of the swelling buds. In apple trees, xylem formation was at least three weeks later m the four- than m the one-year-old shoots, whilst on the one occasion in which a standard plum tree was cut down, on the date of cutting, June 15, 1926, no xylem was forming in the trunk at eighteen inches from the ground, although several rows of xylem elements were present in the one-year-old shoots. These observations confirm and extend the work of the East Malling station published in a previous number of the same journal.

A Cambrian Fish.—In the fifteenth biennial report of the Vermont State Geologist, recently published, Dr. William L. Bryant describes the impression of a small fossil from the Cambrian shale of Franklin County, Vermont, U.S.A., which he considers may prove to be the dermal tubercle of a primitive fish. It is an ellipsoid plate 3 min. in length, truncated at one end. Its outer face is ornamented with rows of tubercles, which radiate from a point near the truncate border. Dr. Bryant compares it with the polygonal head-plates of the Cephalaspids, and proposes the name *Eorchthys howells* for the supposed fish to which it belongs.

Some Helicinne from Mexico and Texas.—Dr. Pilsbry has been studying "The Structure and Affinities of Humboldtiana and related Helicid Genera of Mexico and Texas" (Proc. Acad. Nat. Sci. Philad., vol. 79). The group of belogonous helices (Helicine) which comprises these genera seems to be as widely distributed in America as in the old world. No doubt the group became established in America in Mesozoic times, and the evolution of its members

has been along various widely divergent lines. The anatomy of Humboldtiana and its allies Lysmoe. Leptarionta, and Tryonigens is fully described and illustrated with text figures and four plates. The representations of the enlarged surface sculpture of the shells are especially well done.

DECLINATION CHANGES IN GREAT BRITAIN -The Meteorological Office has published as Geophysica Memoirs, No. 35 (price 3s 6d net), "A Comparison of the Records from British Magnetic Stations Underground and Surface," by Dr. C Chree and R E. Watson The purpose of the work was to find to what extent the changes of magnetic declination in the south of England agree with those in other parts, particularly the mining areas, and below ground as well as above. Since 1918 two-hourly values of the declination, at Kew until the end of 1924, and since then at Abinger, have been supplied to certain journals for the use of mine-surveyors, henceforward they are to be replaced by hourly values The present investigation indicates that on quiet days these values fairly represent the changes of declination throughout Britain, and that there is no appreciable difference in the changes below ground. On disturbed days, however, the changes of declination, both regular and irregular, increase in size as we go north, on highly disturbed days, or even on quieter days in the case of short period changes, the increase with latitude is rapid by 50 per cent at Eskdalemuir, and more than twofold at Lerwick in the Shetland Isles

LIGHT QUANTA —A recent paper communicated by Prof M Planck to the Franklin Institute (Die Naturwissenschaften, June 30) contains some of the views of this eminent theoretical physicist on the trend of modern work. In his opinion, the existence of quanta was definitely proved when, in order to obtain agreement with the results of experiment, it became necessary to supplement the fluctuations in the energy of black-body radiation predicted by classical theory, by other fluctuations, also based on considerations of entropy, which required the presence of discrete units of energy. He regards the partial coherence of quanta which is needed to account for interference as connected in some way which has still to be specified with the classical contribution to the fluctuations, and in concordance with other relations of general mechanics and atomic physics, he looks upon radiant quanta as having an extension in the generalised space of the theory of relativity. Prof. Planck believes that the most important problem awaiting solution at the present time is that of the relation between the corpuscular equations and the wave equations in the most general case, since this is needed to connect the mechanics of a particle moving in a path of large curvature with the properties of radiation of high frequency.

Spectrometer Measurements of Soft X-Rays—There is a short paper by J Thibaud in the Comptes rendus of the Paris Academy of Sciences of July 4, in which he describes a grating spectrometer suitable for work in the soft X-ray region. The radiation produced by election bombardment of a suitable target is limited by fine slits, and then analysed at grazing incidence with one of Prof R W Wood's glass gratings, with 25,000 lines to the inch. One plate which has been reproduced shows the Ka line of carbon in three orders, as well as a sharp K line of oxygen. Apparently the success of the method is due to a high efficiency of conversion of kinetic energy of elections into characteristic radiation of about 30 Å.U, as the necessary exposures of the carbon line could be made on oiled plates in minutes, five

with a dissipation of only ten watts in the X-ray tube It is claimed that the wave-length measurements of the  $K\alpha$  lines of oxygen and carbon, and of the  $L\alpha$  line of non and the  $M\alpha$  line of molybdenum have been made with a relative accuracy of 0 1 per cent, and an absolute accuracy of 0 5 per cent.

EXPLOSION OF LEAD BROMATE —A serious explosion resulting in two deaths is reported by the Chemker-Zeitung to have been caused at Seelze near Hannover on May 26 by the grinding of lead bromate in a mortar. The salt, which hitherto had been prepared from lead carbonate and bromic acid, was on this occasion precipitated from solutions of potassium bromate and lead acetate, and had been well washed on a filter and dried in the oven at 70°-80° C. Grinding 1 kgm of it in a mortar caused a very violent explosion and considerable damage was done.

HARDENING STONE -The method of hardening calcareous stone by treating it with a solution of silicate of soda, discovered by Kuhlmann nearly a century ago, has at various times been used to harden the surfaces of roads, but the results obtained have varied so much with the stone used, the method of application of the solution, and the weather conditions at the time, that it has fallen into disfavour Recently, however, both in Great Britain and in France, attention has been again directed to the method, and in the issue of the Bulletin de la Société d'Encouragement pour l'Industrie nationale for May, M. R Feret, head of the laboratory of Ponts et. Chaussées of Boulogne, gives an account of the observations he has made on the nature of the hardening process and the influence on it of the conditions under which it takes place. His solution contained 24 9 per cent. of SiO<sub>2</sub> and 7 3 per cent. of Na<sub>2</sub>O and was used on rocks of many kinds. He concludes that the hardening process is due to adsorption of the silica at the surface of the stone in a gelatinous form which slowly becomes hard and insoluble. The process is facilitated by drying, by dialysis in the stone, and by the action of the carbon dioxide in the air.

PULVERISED FUEL AT SEA.—Now that the use of pulverised coal has been successfully applied in land boilers, its adoption in marine boilers is thought by some to be only a matter of time. The importance of the subject was referred to in a recent paper, "Pulverised Fuel tor Marine Pulposes," by Engineer-Captain J. C. Brand of the Australian Navy, read to the Institution of Naval Architects at Cambridge, and by various speakers who took part in the discussion Capt. Brand dealt with the practical problems involved and the economy of the system, and gave some drawings of typical installations. For certain services the fuel would be pulverised ashore and conveyed by piping into the ships' bunkers, but in other cases ships themselves would be fitted with the necessary pulverising plant With the improvement in combustion resulting from the burning of the coal in the form of very fine dust, it was stated that a vessel could go 15 per cent. to 30 per cent. farther with the same weight of fuel as compared with the distance she could steam with mine coal. Then, too, with pulverised fuel there is a great reduction in the number of firemen. There are to-day many types of pulverising mills, conveyors, burners, etc. As regards the dangers of using pulverised coal, these have been greatly exaggerated in the same way as were the dangers of oil fuel. So long ago as 1917, Capt. Brand carried out experiments for the Naval Board, Commonwealth of Australia, and in his paper gave the results of tests made in H.M.S. Sealark.

# Chemistry in 'Iraq and Persia in the Tenth Century A.D.

AN important communication with the above title appears in the Memoirs of the Asiatic Society of Bengal, vol. 8, No 6, pp 317-418 (1927), the authors being Principal H. E. Stapleton, of Presidency College, Calcutta, the late R. F. Azo, and M. H. Husam, professor of Arabic at Presidency College. The principal object of the paper, which is provided with numerous references and notes of great value, and is illustrated, is confined to supporting the thesis that "in 900 AD. such a degree of exact knowledge of chemical substances and apparatus was displayed that historians may henceforward be justified in antedating the birth of scientific chemistry by—in all probability—at least 900 years, and, secondly, to indicating briefly the influences, both personal and racial, that appear to have controlled the development of chemistry in the period of investigation

There is nothing in the paper which would incline any one acquainted with the works of the Greek-writing practitioners of the 'Divine Art' at Alexandria, some 500 years before the period dealt with in the present memoir, to assent to the first part of the thesis, and it is much to be regretted that the enthusiasm of some writers on chemistry in Islam should often lead them to overstep the bounds of

reality.

The subject matter of the memoir falls naturally into two parts The first contains an account of the chemical information contained in two treatises written by Muhammad bin Zakarīyā ar-Rāzī, who is generally known (and will in what follows be called) by the name of Rhases (although this is really his address), and an encyclopædia of sciences written about A.D. 980 by Abū 'Abdallāh Muhammad bin Ahmad bın Yüsuf al-Kātib al-Khwārazmī, the Arabic text of which was published by Van Vloten in 1895; an English translation of the part of the latter dealing with alchemy is given.

Rhases was born in A.D. 866 at Ray, and was, like many other Arabic writing men of learning, a Persian. Rhases' treatises on alchemy are said by our present authors to be "scientific works in the modern sense of the word," and free from that "veil of mysticism with which even Jabir had continued to conceal from public view the mass of chemical facts that had gradually accumulated in the Near East up to the middle of the eighth century A.D." It may be useful to notice at this point that the writings of Jabir ibn Hayyan do, in fact, contain a good deal of childish mysticism, and that the claims put forward for his

'rationalism' are exaggerated.
One of the sources of Rhases' information, according to our present authors, was the "Book of the Seventy," a Latin translation of which in the Paris MS, Latin 7156 was mentioned by Hoefer in 1842 ("Histoire de la chimie," vol. 1, p. 409, 1842: "Liber de Septuaginta translatus a magistro Renaldo Cremonensi de lapide animali"—a treatise which, says Hoefer, "pourrait beaucoup intéresser les amateurs de la science hermétique. Il a été, selon toute apparence, traduit de l'arabe"). It was published by Berthelot in 1906, after he had suggested in 1893 that it was the work of the same title attributed to Jābir ıbn Hayyan in the "Kitab al Fihrist" of al Nadim. This has been confirmed, since the present memoir was written, by Julius Ruska, who has discovered the Arabic original. "The substances, apparatus, and processes mentioned by ar-Rāzī are, almost without exception, found in the 'Book of the Seventy.'" The authors proceed to demonstrate in detail the indebtedness of Rhases to Jābir ıbn Hayyan.

The second part of the memoir deals with the interpretation of the word Khārsīnī, which is mentioned as one of the metals in the treatise published by Van Vloten It is there said to be "a rare inetal, almost unprocurable" It is associated with the planet Mercury, and this leads the authors to a discussion of the planetary idols of the Sābians of Haiian, which are described in a treatise of Al-Dimish ( $\bar{q}$  (d A.D. 1327) translated by Chwolson, and also in full by Mehren "Manuel de la cosmographie du moyen âge," Copenhagen, 1874), in which the idol of Mercury "is made of an alloy of all the metals as well as of Khārşīnī, and in the hollow of which much quicksilver is poured " (Mehren translates Khārṣīnī as "Chmese porcelam," as does Chwolson). The literal meaning of Khārṣīnī is, according to the authors, "the Barb, or [poisonous] arrow-head of China"; it takes the place of glass in Jābir's list of the metals, and after an exhaustive examination of the other sources of information (in which they refer to "a further possible source of Arabic alchemy, viz., the Chinese School of Alchemy which was flourishing at least as early as B c. 200, and of which the chief exponent, Ko-Hung, wrote his treatise on Taoist Philosophy and Alchemy, called the *Pao p'o tsz'* in AD. 330"), they conclude that "the original Khārsīnī of ar Rāzī represented the metal now known to us as zinc."
They also refer to "the Chaldwan element in ar-Rāzī's chemistry, as indicated by the inclusion of Khārṣīnī in the list of metals," and suppose that "the ancient civilisation of Mesopotamia had still survived in his time at Harran" (a part of which comprised the Sabian planetary religion mentioned above), and that Chinese information was also available to him there. "Greek and Chinese alchemy must have had some common source of origin: and as the Chinese could hardly have drawn directly on Greek (or Egyptian) sources for this knowledge, China must either have discovered the facts for herself, and passed them on to some intermediary, like Babylonia, or acquired the knowledge from the same (or some other) intermediary. . . . In addition to the Greek knowledge of chemistry, which reached him through Jābir, ar-Rāzī also drew-in all probability through the Temple-priests of Harran in northern Mesopotamia—on the considerable body of knowledge at the disposal of the ancient Babylonian and Egyptian priests."

It is suggested that such information as that translated in R. C. Thompson's "Chemistry of the Ancient Assyrians" may have been transmitted directly, together with unspecified elements from other civilisations. This suggestion is clearly worth following up, since the usual opinion that chemistry is largely of Egyptian origin was put forward at a time when practically no information existed as to the technical knowledge of that people. Exaggerated claims for "a Babylonian origin of alchemy," such as those of Eisler, are still without confirmation, but the possible contributions from Mesopotamia grow more probable with fuller knowledge. In this connexion there is an interesting suggestion of Ruska (" smaragdina," p. 22) that the καιρικαί βαφαί of the Greek alchemical MSS. refers to the colorations of metals in the interior of the earth, which were formerly engendered by the action of the planetary spirits, but in the period when these actions had coased, could be effected by the 'divine art' of chemistry. This, in turn, seems to be related to the old Babyloniun belief in "spirits of mineral treasures" living under the earth, and related to the fire god.

The Chinese element assumed by our authors is

awaiting investigation, and it may be that Rhases' account of  $\underline{K}$ hārsīnī refers to mercury as a compound such as corrosive sublimate, which would correspond better with the Sabian account and with the poisonous properties of the material. I-Tsing (A.D. 671-695) seems to know corrosive sublimate, the production of which in China may have been early.

It has been possible only to mention one or two of the numerous interesting matters dealt with in the memoir, and the authors have performed a most useful and valuable service in its publication Students of this difficult period in the history of chemistry will await with keen interest the further memoirs which Principal Stapleton promises. J. R P.

# The Empire Mining and Metallurgical Congress.

THE first Empire Mining and Metallurgical Congress was held in 1924 at Wembley, on the occasion of the Butish Empire Exhibition, and the second will open at Montreal on Aug. 22 conferences are for the discussion of scientific, technical, and economic problems connected with the mineral industry, and they have in view the development of the mineral resources within the Empire They are arranged by an Empire Council consisting of delegates from five constituent institutions domiciled in Great Britain and five domiciled oversea.

The convening body for this second Conference is the Canadian Institute of Mining and Metallurgy. Invitations have been widely accepted from Great Britain, South Africa, Australia, and elsewhere within the Empire, while in addition many members of one or other of the institutions resident in the United States will attend. Probably, therefore, including ladies, there will be some 750 participants

The venue of the conference in Canada is a particularly happy one, not only because this year is the diamond jubilee of the Dominion's Confederation, but also because the mineral industry in Canada has risen so rapidly to a position of great importance that it may be regarded as being on the threshold of further

important developments.

The congress will begin by a session at Montreal on Aug. 22, and it will end by return to the same capital city on Sept. 28 Intermediate sessions will be held at Toronto and Winnipeg in succession, Intermediate sessions will the major portion of the conference then proceeding westward to Vancouver to visit Edmonton on the return, at both of which places there will be further sessions, while the remaining participants will turn eastward from Winnipeg to hold a session at Sydney in Nova Scotia. There will be, accordingly, full opportunity to visit all of Canada's important mineral fields from the Atlantic to the Pacific.

With the greatest sympathy, interest, and assistance from the Dominion and Provincial Governments. as well as from the Canadian mineral industry itself. the presentation of Canada's mineral resources to the visitors will undoubtedly be as complete as the best possible auspices can ensure.

The wider question of the Empire's mineral resources will be the feature of the discussions at the opening session at Montreal, when papers dealing with it will be presented, particularly from the Institution of Mining and Metallurgy, London So important, indeed, does that Institution consider the question to be that it has forwarded to the Conference the following resolution · "Resolved: That the Council of the Institution of Mining and Metallurgy being of opinion that the questions raised in the Paper submitted to the Institution by Sir Thomas Holland on a 'Proposed Review of the Mineral Resources of the Empire' are of vital importance to the British Empire as a whole, and to the Dommons, Dependencies, and Colonies, as units, think it desirable that they should receive serious consideration and discussion by competent authorities within the Empire.

Apart from this outstanding question, the Conference has been presented with an abundance of valuable papers from the other institutions and from prominent individuals, on the closer problems of the industry, scientific, technical, and economic. wherefrom all participants, whether from the homeland or from overseas, are assured of a lively and sustained interest in the proceedings. That interest, sustained interest in the proceedings the delightful tour, and not least the friendliness promised both in Canada and on the way there, constitute a sum of entertainment which explains the large number who have seen their way clear to

It is understood that the next of these Conferences will take place in South Africa in 1930.

## Mycorrhiza.

DR. M. C. RAYNER concludes her series of papers on mycorrhiza in the May issue of the New Phytologist. The final chapter is devoted to a consideration of the significance of these structures, and the nutrition of mycorrhiza plants. The author holds a brief for the view that the relationship between tungus and host plant is a reciprocal one beneficial to both symbionts, and implies an exchange of food material with a credit balance on the side of the vascular plant.

Evidence is adduced from experimental work on the relationship in forest trees, orchids, and heaths. In the case of conifers, the fungi concerned show marked stimulation in contact with the roots, due no doubt to the small quantity of exudates, particularly phosphatids, present. The infected root, on the other hand, seems to absorb morganic salts as well as, or in raw humus soils, better than, the uninfected roots. It is pointed out that the struggle for existence often centres about competition for suitable compounds of nitrogen, and the mycorrhiza habit enables the plant to draw efficiently on sources of nitrogen in the soil otherwise unavailable for its use.

On the other hand, there is no evidence that any of the known root fungi of trees can assimilate free nitrogen. While conifers can utilise ammonium compounds. more complex organic nitrogenous compounds are more readily utilised by the root fungi, and on acid humus soils, where such compounds constitute the chief source of nitrogen, plants with mycorrhiza are well equipped in competition with other forms. Orchid mycorrhizal fungı differ from those of conifers m retaining the power of autonomous existence. Seedling development is, however, conditional on infection. In the case of chlorophyllous forms, whether or not the mature plant can thrive in the absence of infection is an open question, but with non-chlorophyllous species, complete dependence on fungal symbionts is a condition of existence, as the food material of the plant must come from the humus in the soil.

The structural features of heath mycorrhiza

resemble those of conters more than of orchids. Calluna grows in human soil where there is a deficiency of mineral salts, particularly intrates, and mycorrhiza have been found most profusely developed in soils with abundant human, more sparsely in dry sandy situations, so it is possible that the beneficial effect upon the host may be directly related to soil conditions. Here again the mycorrhiza probably functions similarly to that of trees, enabling the plant to draw upon organic reserves in the humans.

In its evolutionary aspects the relationship now existing in orchids and heaths is considered to have originated in parasitism on the part of certain soil fungi. For this hypothesis it is necessary to assume that the invading strains were relatively mild in their action, and that the hosts had a relatively high resistance to parasitic attacks. Given this, it is easy to reconstruct the first stages of a symbiotic

association.

# University and Educational Intelligence.

CAMBRIDGE.—The John Winbolt Prize in engineering has been awarded to C Hinton, Trinity College, and W. R. D. Manning, Sidney Sussex College, for a joint dissertation on "Transverse Oscillation of Bridges"

SYDNEY.—Prof. R. S. Wallace, professor of English language and literature in the University of Melbourne, has been appointed vice-chancellor of the University of Sydney. He will succeed Sir Mungo MacCallum, who, at the special request of the Senate of the University, has consented to continue to discharge the duties of the office during the present year.

The following research scholarships at the Huddersfield Technical College are being offered by the Huddersfield Education Committee: A Drapers' Company's, in dyeing, value £100 with remission of fees; a Joseph Blamires, for research in colour chemistry, value £100 with remission of fees; and a British Dyes, for research in colour chemistry, value £75 with remission of fees. Particulars and forms of application are obtainable from the Technical College, Huddersfield.

In the seventh series of "Methods and Problems of Medical Education," recently issued by the Rockfeller Foundation, the School of Medicine and Dentistry of the University of Rochester, Rochester, N.Y., is described, with full details and plans of the buildings and many illustrations. The building embodies many novel features, and efficiency with economical construction has been the aim throughout. Corridors have been kept at a uniform width of 8 ft., and the distance from floor to floor is 11 ft. 2 in. Throughout all parts of the school the inner surface of the building walls are faced with an inexpensive grey 'sand-lime' brick, which reflects the proper amount of light for general laboratory work. Partition walls are constructed of 'sand-lime' brick of single thickness, strengthened by steel door frames anchored to floor and ceiling. No plaster has been used except in tollet rooms, all walls, columns, and ceilings are untouched by paint, and all pipes are exposed. The cost per cubic foot, including everything except equipment, is 39 cents for the school and 62 cents for the hospital, and equipment costs 4 cents for the school and just over 6 cents for the hospital, per

Prof. H. B. Fantham, professor of zoology in the University of the Witwatersrand, has published in the

South African Journal (vol. 23, p. 595) the address he delivered in 1926 at a joint meeting of Sections D and F of the South African Association for the Advancement of Science on the question of the teaching of animal biology in the Transvaal. In the course of the address he says, on the authority of Dr. Skaife, that in the Cape Province animal biology is now a compulsory subject in all the secondary and high schools. and that in 1925 no less than 2000 candidates took the subject in the junior certificate examination this respect the Transvaal apparently lags behind, and Prof. Fantham gives in his address reasons why biology should be taught in all the high schools throughout South Africa, and some practical suggestions as to the materials that might be used to illustrate the principles of the subject. In the Report of the British Association in 1921 a statement, drawn up by the Zoology Organisation Committee, was published on the teaching of natural history in the schools of Great Britain, in which similar reasons were given for the inclusion of the subject in all schools and a practical course was suggested. There has been some improvement since the date of the Edmburgh meeting, but education authorities in Great Britain are still far behind the Cape Province in their appreciation of the value of animal biology as a school subject. Prof Fantham's suggestions for courses on animal biology indicate the wealth of material there is in South Africa for teaching purposes and is of interest to zoologists, but the school authorities would probably be more impressed by a shorter and more concise proposal for a course of study. It is obvious that no school could ever cover the ground of his list of possible studies, and the head-masters will look to the professional zoologists for something more limited in scope that it would be practical to carry out in the limited time and equipment at their disposal.

RESEARCH in secondary education in the United States is held to be of such importance to the nation that a national committee has been formed for the purpose of promoting and guiding it. The Federal Bureau of Education, which is represented on the committee by its Commissioner, J. J. Tigert, and by E. E. Windes, who acts as secretary to the committee, has recently issued as Bulletin, 1926, No. 21, an outline, sponsored by the committee, of methods of research, intended for the guidance of school principals and teachers who wish to investigate some phase of secondary school work. The bulletin points out that helpful and indispensable as is laboratory research, its experiments are usually performed on selected groups under conditions which often simulate very imperfectly those of actual school life; likewise that much research can be carried out only in the classroom. Hence the importance of helping the school principal to develop in himself and his teachers an attitude of scientific research toward the problems that confront them and to acquire the requisite technique for conducting and reporting investigations. Chapters on the conditions essential to scientific research, the qualifications for the research worker, and types of research problems, are followed by a criticism of the questionnaire method of investigation in which wholesome warnings are given as to its many demerits. A useful outline of desirable procedure to be observed in reporting the investigation and its results follows, and there are a descriptive list of established research agencies and a bibliography of fifty recent publications. So many problems connected with secondary education in Great Britain require immediate attention to-day that this bulletin (Government Printing Office, Washington, D.C., 10 cents) should find readers among English secondary school principals.

# Calendar of Discovery and Invention.

August 15, 1869.—Imperishably associated with the name of de Lesseps, the construction of the Suez Canal was regarded as one of the greatest works undertaken. First suggested by de Lesseps in 1854, work was commenced in 1858, and on Aug. 15, 1869, the waters of the Mediterranean mingled with those of the Red Sea. When de Lesseps died, Engineering referred to the canal as being "far more truly the work of Lesseps than was the railway of Stephenson, the steam engine of Watt, and the spinning machine of Hargreaves."

August 16, 1822.—The discovery of thermoelectricity was first made known by Thomas Seebeck (1770–1831) on Aug. 16, 1822 Seebeck's early experiments were made with copper and antimony and

then extended to other pairs of metals.

August 16, 1814.—Brewster, while on a trip to Paris, recorded in his diary on Aug. 16, 1814, a visit to the Institute, where the business included a report by Poisson, a proposal by Legendre, and a long paper on iodine by Gay-Lussac. Of some of the famous men of science present he left interesting notes, describing Legendre as "a very tall and very thin man, with an expressive and intelligent countenance, white powdered hair, tied and curled above the ears"; Poisson as "a young and active little man, with a sweet and expressive countenance"; Delambre as "a little, oldish man, very yellow; a little marked with the small-pox"; Monge as "below the middle size, stoops, has a full face, and white curled hair"; and Lamarck as "a good-looking old man, with a light coat and an embroidered waistcoat, little and rather crooked."

August 17, 1807.—Fulton's famous Clermont—the first regular passenger steamboat in the world—made her trial trip on the Hudson on Monday, Aug. 17, 1807. Fulton's own statement ran: "I left New York on Monday at 1 o'clock and arrived at Clermont, the seat of Chancellor Livingston, at 1 o'clock on Tuesday; time 24 hours; distance 110 miles. On Wednesday I departed from the Chancellor's at 9 m the morning and arrived at Albany at 5 in the afternoon; distance 40 miles; time 8 hours; the sum of this is 150 miles in 32 hours—equal nearly 5

miles an hour."

August 18, 1854.—To Charles Bourseul (1829–1912), a French postal employee, we owe one of the first suggestions for a telephone. In an article in *Illustration*, Aug. 18, 1854, he suggested using vibrating plates to establish and interrupt connexion with an electric coil which acted sympathetically on a second

vibrating plate.

August 19, 1868.—During the total solar eclipse of Aug. 18, 1868, Janssen, "inspired by the beauty and brilliancy of the variously tinted prominence-lines revealed to him by his spectroscope, exclaimed to those about him, 'Je verrai ces lignes-là en dehors des éclipses.'" On the following morning he carried into execution the plan which formed itself in his mind while the phenomenon which suggested it was still before his eyes, and, says Miss Agnes Clerke, "During the whole of that day [i.e. Aug. 19], and many subsequent ones, he enjoyed, as he said, the advantage of a prolonged eclipse."

August 20, 1841.—In the study of physiological chemistry none did more important work than Liebig in Germany and Dumas and Boussingault in France. Liebig's report to the British Association on animal chemistry was made in 1842, while another important contribution was the lecture of Dumas and Boussingault, "Statique Chimique des Etres Organisés," delivered on Aug. 20, 1841. E. C. S.

## Societies and Academies.

#### LONDON.

Geological Society, June 15 —J E Richey: The structural relations of the Mourne granites (Ireland). The Mourne Mountains are some 13 miles long by about 5 miles wide, and include many peaks of more than 2000 feet in height. The granite-massif of inferred Tertiary age is intruded into Silurian shales, and truncates a north-westerly basic dyke-swarm The massif consists of at least four distinct intrusions, composed of different granite varieties. The Western Granite extends outwards on all sides below a slightly domed roof of shales, cappings of which rest upon the granite. The Eastern Granites are deeply eroded enough to show bounding walls as well as roofs. Floors are nowhere seen These Eastern Granites are arranged one within the other, with a marked excentricity towards one side. The outermost granite is the oldest, the innermost the youngest. Features observed by Traill are that granite-margins transgress the bedding of the Silurian shales, and that the direction of the dip of the shales is unaffected by the intrusion of the granites. The absence of xenoliths, except at actual margins, and the plane surfaces of contacts, are other noteworthy features. The spaces occupied by the various granites have been provided by subterranean cauldron-subsidence of the pre-The intrusion of the Eastern Granites existing rocks successively one within the other may be then explained by assuming renewed subsidence of the first-subsided block.—W. F. Whittard: The stratigraphy of the Valentian rocks of Shropshire: the main outcrop. It is the first of these that is described in this paper. The threefold classification of Salter and Aveline has been adopted, but their nomenclature has been modified: the rocks are subdivided as follows: (3) Purple shales; (2) Pentamerus beds; (1) Arenaceous beds. The Arenaceous beds extend from near Cardington north-eastwards to the Wrekin, and consist essentially of conglomerates, grits, and sandstones. Evidence is given for a southerly derivation of the pebbles comprising these beds, and Purple shales consist almost entirely of purple, maroon, or green mudstones or shales; shelly limestones and calcareous sandstones occur irrespective of horizon. The Valentian rocks are displaced by a series of dip-faults, but no folding, other than that caused by slip, has been detected. The Valentian rocks of the main outcrop seem to have been deposited in partly isolated or protected waters. The few graptolites so far obtained show that only Upper Valentian rocks are exposed.

### CAMBRIDGE.

Philosophical Society, July 25.—C. E Wynn-Williams A valve amplifier for ionisation currents. A method of using a valve for amplifying ionisation currents 100,000 times is described, which avoids the instabilities usually associated with such apparatus. Used in conjunction with a galvanometer of sensitivity 200 mm. per microampere, the system behaves in a similar manner to a low capacity quadrant electrometer of sensitivity 6350 mm. per volt, shunted by a leak of 360 megohms, the valve of the latter being slightly greater for negative currents than for positive.—C. F. Sharman A differential retarding potential method for the study of the energy distribution of slow electronic emissions. A discussion, given in a previous paper (*Proc. Camb. Phil. Soc.*, Pt. 5, vol. 23, p. 523), of the respective merits of the magnetic spectrum and of the ordinary retarding potential

method for the investigation of electron energy distributions is here elaborated, and the difficulties peculiar to the low energy region (from zero to 20 volts) are pointed out. Results of the application of the method to the secondary electrons excited in a copper surface by primary electron beams of energies from 200 volts to 800 volts are described —W. L. Webster The Hall effect in single crystals of iron. Experiments were made to determine whether the Hall effect varied with the direction in the crystal for which it was measured. The Hall potential was measured in four thin plates cut from single crystals, with quite different orientations For all of them, the Hall coefficient was the same within the limit of experimental error, having a value +0 97×10-2 -L H. Thomas The production of characteristic X-rays by electronic impact Two corrections are made to Rosseland's formula for the variation of the intensity of characteristic X-rays with the energy of the exciting electrons The velocity m its orbit of the electron knocked out of the atom and the increased velocity of the impinging electron are taken into account. The formulæ are compared with Wooten's experimental results for the  $K_a$  line of molybdenum.—F. P. White: Simplexes and other configurations upon a rational normal curve—R. W. Ditchburn: Notes on spectro-photometry

## PARIS.

Academy of Sciences, July 4 - Hadamard · The shuffling of cards.-H. Deslandres: The law of distribution of magnetic storms and of their elements Consequences regarding the constitution of the sun. J. Costantin: An attempt at a theory of the altitude cure (plants).—Paul Sabatier · The inversion of the rôle of catalysts.—Riquier : The integration of the partial differential equation of the second order linear in r, s, t, in the case where the coefficients of the three differentials depend only on the variables x, y — Jules Andrade: The maximum of isochronism realisable to-day by elastic regulating organs. -- J. Lebel. Analytical functions and the deformation of the paraboloid of revolution .- Octav Onicescu. The representation of a function on an ensemble of saturation of dimension zero —A. Véronnet: The impossibility of a Poinsot movement for an isolated heterogeneous fluid mass —André Planiol · The production of shocks in the heads of connecting rods -P. Fatou . Periodic orbits — Jean Mascart · Observation of the partial eclipse of the sun of June 29, 1927, at the Lyons Observatory.-V. Nechvile: The frequency of the apparent movements of stars —Fernand Baldet: The nucleus of the Pons-Winnecke comet (1927c). -D. J. Struik and Norbert Wiener: The relativist theory of quanta - Nageotte: The elementary plates of myeline in the presence of water.—J. Cayrel: The contact metal—cuprous sulphide.—Thadée Peczalski: Theory of the sub-electrons .- Max Morand: The distribution of the electric field in the dark space.— C. Bouhet: The application of the general method of Chaumont to the measurement of the elliptical polarisation produced by reflection at the surface of liquids.—Tsukamoto: The transparency of fused silica for ultra-violet radiations. The absorption of ultra-violet rays of short wave-length by fused silica appears to be variable from one specimen to another, a difference probably due to impurities. But even with the purest material used, prepared by fusing clear quartz, the absorption is still stronger than with crystallised quartz.—Bovis : The absorption spectrum of bromine in solution. The band  $0.414\mu$  appears m the absorption spectrum of bromine in all states, gas, liquid, and in solution, but the ultra-violet band  $0.260\mu$  is only given by bromine in solution.—H. Volkringer: The continuous spectrum and bandspectrum of mercury -Jean Thibaud: The spectrographic connexion of the domain of the X-rays with the ultra-violet by the aid of ruled gratings -Mario A da Silva The deformation of the ionisation curve m pure argon by the addition of oxygen. The experimental relations found between voltage and saturation current of pure argon and admixtures with oxygen are given graphically. - A Tian. Equilibrium in a gaseous phase between acid and base: the volatility product.—Amand Valeur and Paul Galhot The oxidation of cacodyl oxide. The gradual exidation of cacodyl oxide by means of oxygen gas gives cacodylic acid as the main product together with trimethylarsme, monomethylarsme oxide, and arsenious acid. - Mile Shioldvor Grundt: The estimation of lead as cyanide Herz and Neukirch have proposed to estimate lead as the eyanide by precipitation with potassium eyanide. A repetition of these experiments showed that lead eyanide is not formed under these conditions: the precipitate weighed is a lead basic carbonate, which happens to, contain the same percentage of lead as Pb(CN)<sub>3</sub>,— F. Blondel. The red earths and the phenomena of alteration of rocks in French Indo-China --A. Loubière. The coal flora of the Albi basin. The plants found are intermediate between the Stephanian and the Westphalian, and represent a level not hitherto recognised in France.—Mile II. Popovici: Some remarks on the clamplasts of the Hepaties.--J. Chaze: The appearance and localisation of meeting m the young tobacco plant. No trace of nicotine can be found in the seed, but the alkaloid appears in the first stages of germination. In seedlings 3 num. long, meeting is visible a little above the growing point of the root, in the absorbent hairs. It exists also, but in smaller quantity, in the cotyledons.--D. Chouchak: The antagonism between cultivated plants and the bacteria of the soil in their mineral nutrition .-- Georges Truffaut and N. Bezssonoff: The measurement of the assimilability of various phosphates by their action on the bacterial fixation of nitrogen. Fluorides do not interfere with the biological fixation of introgen, and may even exercise a favourable action. The non-assimilability of the natural phosphates is due to their insolubility and not to a toxic action of calcium fluoride Daniel Auger. The electrical reaction of plant cells to polarisation—J. Dadlez: Research on the production of ozone m the air by ultra-violet rays. -C. Levaditi and J. Longinesco - The relations between the spirilheidal and trypanocidal activity of the elements and their electrochemical classification.

## ROME.

Royal National Academy of the Lincei, May 1 .-E Cartan · The geodetic deviation and certain allied notions.—P. Burgatti: The causes of the luminosity of falling stars. This phenomenon appears to be mainly of electrical, and not of thermal, character.— Giorgio Abetti: Activity and height of the solar chromosphere in 1926.—R Nasini and C. Porlezza: Determination of the concentration of active hydrogen ions in Italian inineral waters. The colorimetric method offers advantages in the determination of the hydrogen ion concentration of mineral waters and yields constant results The pH value appears to be of little value in investigating the solutions representing the various stages of the extraction of boric acid at Lardarello.—S. Franchi: Emile Argand's covered fault of Monte Rosa and the permo-triassic anticline Acceglio-Col Longet in the Southern Cottian Alps -F. Zambonini and V. Caglioti: Double sulphates of rare earth and alkalı metals (ix.). Sulphates of neodymium and rubidium. Study of a

portion of the system  $Nd_2(SO_4)_3 - Rb_2SO_4 - H_2O$  over the 25° isotherm indicates the existence of the compound Nd<sub>2</sub>(SO<sub>1</sub>)<sub>3</sub>, Rb<sub>2</sub>SO<sub>4</sub>, 8H<sub>2</sub>O, which is perfectly isomorphous with the analogous double salts already examined and, like these, exhibits typical faces replaced by vicinal faces. The crystallographic constants are a.b.c = 0.3015 + 0.921,  $\beta = 96^{\circ} 40'$ L. Cambi and L Szego Spectrographic study of complex iron cyanides (1). The absorption spectra of the ferripentacyanides and of certain ferropentacyanides reveal marked divergences in the manitestations of the affinity in complex ions, notwithstanding the formal analogies based on the coordination theory.—S Baglioni. Investigations on human physiology at the Central Military School of Physical Education.—G. Ascoli Durchlet's problem in spherical and hyperspherical fields.—E. Pini Investigation of the primitive functions by functions of several variables—J Dubourdieu: Cartesian co-ordinates along a curve—C. Poli: The principles of analytical mechanics—F Sbrana. The spherical vortical motion of an incompressible fluid.—B Finzi · Energetic interpretation of a noteworthy exception to Kutta-Joukowski's theorem.—G. Armellini-Conti: Comparison of the colorimetric catalogues of Hagen. Sestim, Osthoff, and Kruger—F Eredia. Variation of the wind velocity from the ground to a height of 4000 metres, according to soundings carried out at Vigna di Valle (Rome).— N. Carrara: A new type of X-ray reflection -A Carrelli · Paramagnetic double refraction —L Mazza The products formed during the working of lead accumulators In conjunction with the results already obtained, those now furnished by investigation of the negative plates of lead accumulators confirm Gladstone and Tribe's double sulphation theory, and show that the other chemical theories are totally or partially invalid. The active substance constituting the charged positive electrode is composed of lead dioxide identical in crystalline structure with that obtained by chemical means, the almost black colour resulting from prolonged overcharging depending solely on the increased dimensions of the crystalline particles. The spongy lead forming the charged negative electrode has the crystalline structure of massive lead and is not an allotropic modification. Discharge of the accumulator leads to the formation, on both electrodes, of a product identifiable by its crystalline structure with lead sulphate, but probably of colloidal dimensions; this is mixed with considerable proportions of lead dioxide and lead respectively.—Ü. D'Ancona: Influence of the concentration on the loss in weight of young eels fasting in sodium chloride solutions.—V Peglion and M. Sacchetti: The Peronospoia of Illac (Phytophthora Syringæ, Klebahn).—R. Savelli How a semi-mutant is resolved.—S. Campanile: Investigations on the seasonal variations of inorganic nitrogen compounds existing in the Lake of Castelgandolfo. Owing to the development of a rich plankton vegetation the proportion of nitrates in this lake during the warm weather is less near the shores than in the central parts. The fall of meteoric water also has a bearing on this phenomenon, which is contrary to what is usually observed.—D. Cattaneo: Ultramicroscopic investigations on the crystalline lens (ii.). Modifications of the ultramicroscopic structure by the action of salts, alkalis, and acids.

## GENEVA.

Physics and Natural History Society of Geneva, June 2.—W. H. Schopfer. Researches on the sexuality of the heterothallic Mucorineæ. Studying the heterothallic species Mucor hiemalis, the sexual physiological

dimorphism of this species is confirmed. The toxic effect of copper sulphate is different on the two sexes -A Borloz. A critical study of the methods of analysis of antipyrin and pyramidon. After an examination of the known methods, the author recommends for the analysis of a mixture of these two substances the method of Péguner-Lemaire, but avoiding the neutralisation by hydrochloric acid and methyl orange before the precipitation with pierie acid.—E Briner and Ch. Boissonnas: The energy yield of the formation of ozone by the silent the charge. In laboratory researches, the power absorbed in the ozoniser has been too often confused with the product of the voltage by the current. The true yields are up to ten times greater than those intheito calculated, and their relations with the pressure are different -L. A. Deshusses. A correction of the Avery-Beans method (the estimation of arsenic in Schweinfurth green). The comparison of the results of this method with those of the gravimetric method or by distillation of arsenic trichloride in the presence of methyl alcohol has proved that the Avery-Beans method has a systematic plus error -P. Wenger and M. Gysin. The estimation of carbon dioxide in lunestones. limestone is attacked by a boiling solution of sulphuric day from the carbon doxide is fixed by caustic potash. Unlike hydrochloric acid, the sulphune acid is not carried over into the potash tube because its vapour pressure is

#### SYDNEY.

Royal Society of New South Wales, May 4.-W. G. Woolnough (Presidential address). The general chemical principles involved in the weathering of rocks during the last stages of highly perfect peneplanation are discussed, and it is shown that, if the rainfall of the region is markedly seasonal in distribution, the conditions tayour the production of: (1) A very deep zone of completely leached rock, consisting essentially of kaolin and silica, (2) a sub-surface deposit typically concretionary in structure of amorphous silica, alumina, and iron oxide. All the alkalis and alkaline earths are completely removed in solution. An attempt is made to prove that the very widespread 'lateritic' and siliceous crusts so ubiquitous over western and northern Australia, are parts of a single chemically-formed deposit, produced under the conditions postulated in the first part. Such crusts have been referred to a number of different geological formations, and endless confusion has resulted. It is believed that 'Desert Sandstone,' 'Laterite,' 'Upland Miocene,' and other formations in different States may be brought into harmony with one another. For the formation thus produced the name of 'Duricrust' is suggested. Reasons are adduced for assigning the Miocene age to the structure. The Duricrust economic importance as it yields precious opal, fireclays, road metals, water supplies in and regions, and possibly bauxites of economic value. Its surface is mostly extremely barren, and its destruction has given rise to the great stony plains (gibber plains) so widely developed in the interior of the continent. Remnants of it give rise to the 'tent hills' and 'table hills' so characteristic of Central Australia

## VIENNA.

Academy of Sciences, June 17.—D. R. R Burt: The ability of various regions in the body of *Pelmatohydra oligactis* to form head or foot; determination of the totipotent region. Tissue rings were transplanted from one part of the hydra and grafted on to the head or foot region of another specimen.—W. M Diener: New observations on the geological distribu-

tion of fossil calcareous alga -A. Hintringer: The separation of seeds from the placenta and from the pericarp respectively.—E Biel. Climatography of the former Austrian littoral—A. Kailan and E. Goitein: Hydrochloride formation in glycerine and glycol and the esterification of the mon-oxy- and of the 2, 5- and 2, 6-di-oxy-benzoic acid as well as of phenyl-acetic acid.-R. Schumann · On vectorial adjustment of closed geodetic figures in the plane in the case of arbitrary weights for distances and directions.—A. Pongratz · Researches on perylene and its derivatives. -A Zinke, G Gorbach, and O Schimka: Researches on perylene and its derivatives -O. Dischendorfer: On o-nitro-benzal-di-\beta-naphthol.—A. Birula · Scorpions of the Anglo-Egyptian Sudan

June 30—E. Chwalla The stability of girder struts.—F. Feigl and M. Furth: The compounds of nickel with o-phenylene-diamine and 1, 3, 4-toluylenediamine.—L. Schmid and E. Ludwig . Two stearinelike substances in Asclepias syriaca identical with a-and  $\beta$ -amyrin —K. Przibram: Further experiments on the coloration of compressed salts. Many salts sold as chemically pure give pressure colours -A. Kieslinger. Glacial lakes in Eastern Carinthia. The characteristics of such lakes are level terraces mostly of lake sand.—A. Kieslinger: Preliminary report on tectonics of middle Carinthia.—L. Kober: Geology of the Northern Apennines and the adjacent Alps.

—A. Winkler: The tertiary basin of south-west
Styria in the older Miocene—O. Richter: Sodium, a necessary nutritive element for a marine microaerophil luminous bacterium.

## Official Publications Received.

Aeronautical Research Committee Reports and Memoranda No 153 (E 22) Torsional Vibration in Engines Effects of fitting a Aeionautical Research Committee Reports and Memoranda No 1053 (E 22) Torsional Vibration in Engines Effects of litting a Damper, a Flywheel, or a Crank-haft-driven Supercharger. By B C Cattet (B 4 Engines 57 and a, b and c —T. 2227 and a, b and c) Pp 37+19 plates 18 %. net No 1082 (Ae. 281). The Pressures round a Cylinder rotating in an Air Current By Dr A Thom (A 3 t Autogyros, Helicopters and Rotors, 1—T. 2347.) Pp. 12+8 plates 9d net (London. H M. Stationery Office)
City and Guilds of London Institute Report of the Council to the Members of the Institute, 1927. Pp 1vi+85. (London: Gresham College) Effects of fitting a

FOREIGN

Shinsae Yobo Tyosakwai Hôkoku (Reports of the Imperial Earth-quake Investigation Committee.) No 100, C1 Pp. 210+253 plates No. 100, C2 Pp. 211-401+215 plates No. 100, D. Pp. 8+803+250 plates (Tokyo Department of Education)

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 20, Part 1: Über die Entstehung des Corpus luteum beim Kaninchen. Von Shiro Kurashige. Pp. 47+4 Tafeln. (Saddoro.)

CATALOGUES.

A Catalogue of Rare and Valuable Books (mostly Antiquarian), Pamphlets, Excerpts, Periodicals and Plates on all branches of Natural History, with a large proportion of works on Ornithology. (No 1, New Series.)

Pp. 24: (Eastbourne: The Naturalist's Library (A J Retarges)) Bateman))

Catalogue of Atlases, Maps, Sea Charts, Road Books, Military Plans, Facsimiles of Early Maps, and Books of Geographical Interest. (No. 498) Pp. 61+6 plates (London . Francis Edwards.)

# Diary of Societies.

SATURDAY, AUGUST 20

North of England Institute of Mining and Mechanical Engineers, at 2.30 —Annual Meeting

## CONGRESSES.

AUGUST 22-26.

Pathological and Bacteriological Laboratory Assistants' Association (in University Pathology Department, Cambridge).

August 22 — At 10 30 A M.—W. A. Mitchell: Cambridge (Lecture).
August 23 — At 9 30 A M.—A. E. P. Grimmo: The Manufacture of Smallpox Vaccine as carried out in the Laboratories of the Shanghai Municipal Council.

J. J. Ritchie Antagonism and Symbiosis of Bacteria.

Prof. G. H. F. Nuttall . The Development of Parasitology.

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August 24.—At 9 30 A M —S J Denyer Virulence Tests in the Identifica-tion of B. Diphthero

tion of B. Diphthero
A. Saunders. Diversions of an Overseas Laboratory Assistant.
J. McLean. Rare Faceal Organisms which simulate Pathogens
August 25—At 9 30 a.m.—F. Leeson. The Preparation of Plague Vaccine
S. Linfoot. Laboratory Work in a Spa Hospital
E. Steele, J. McLean, and others. Discussion. on Laboratory
Feonomics.

Economics.

EMPIRE MINING AND METALLURGICAL CONGRESS

Inquist 26—At 9.30 a m — Demonstrations of Exhibits

Empire Mining and Metallurgical Congress

Monthead Meetings, August 22 and 23—Sit Thomas Holland Proposed Review of the Mineral Resources of the Empire—G. M. Carlie and C.S. Pascoe Magnesia Refractories for Steel Fiunaces — A Stansfield. Smelting Titaniferous Iton Ores —W. A. Tooley. Portland Cement in Canada — Mining and Metallurgical Practice in Australia — Health Safety Problems

Torotto Meetings, August 25 and 26—C. Johnson. Winning and Refining of Precious Metals from Sudbury Ores — R. C. Stanley. Nickel, Past and Present—A. A. Cole. The Silver Mining Industry of Canada—J. G. Morrow. The Cascade Method of Pouring Steel—A. Mayrogordato and II. Prow. Deep Level Mining and High Tempetatures.

Winnipeg Meeting, September 3—G. E. Cole. The Development of Gold. Mining in Canada—W. A. Quince. Methods of Eliminating Barren. Rock from Ore at the Sub-Nigel Mine—C. R. Davis, J. L. Willey, and S. E. T. Ewing. Notes on the Operation of the Reduction Plant at West Springs, Ltd.—E. J. Laschinger. A New Formof Air Meter and the Measurement of Compressed Air.

Vancouver Meeting, September 14—C. P. Browning. Canadian Copper and its Production.—F. J. Alcock and T. W. Bingay. Lead and Zine in Canada—C. J. N. Jourdan. A. Brief Review of the Principal Base Metal and Base Mineral Resources of the Union of South Africa—R. Craib. Dewatering the Lower Levels of the Simmer and Jack Mines, Ltd.—W. S. Robinson. Manufacture of Sulphuric Acid by the Contact Process. From Zime Blende Roaster Gases.

Edmonton Meeting, September 20—R. Strachan, W. J. Dick, and R. J. Lee. The Coal Industry in Western Canada—J. News. Petroleum in Canada.—A. Docquier, L. Bataille, and R. Beetlestone. A. Combination of the Baum, the Draper, and the Froth Flotation Systems as applied to the Washing of Coal at the Linis Mine of the Kailan Mining.—A. W. Nash: Possible Auxhary Sources of Liquid Fuel.—A. Job. The Sinking and Equipment of the Ventilation Shaft of the Government Gold—Mining Alcons.—F. M. Newhall an

AUGUST 27-SPPILMBUR I

International Congress of Orientalists (at Oxford) In following sections General (including Anthropology, Ethnography, Prehistoric Archaeology, Comparative Mythology, and Folklore), Assyriology and cognate subjects, Egypt and Africa, Central and Northern Asia, the Far East, India and Iran, including the Indo European Languages of Asia, the Old Testament, the Language, Literature, etc., of Islam, and Omatical Art and Oriental Art.

INTERNATIONAL COMMISSION FOR THE EXPLORATION OF THE UPPER AIR (at Leipzig).

SEPTEMBER 1-4.

Schweizerische Naturforschende Gesellschaft (at Basel) (in 14 . Sections).—Presidential Address by Dr. F. Sarasin.—Lectures on, 1espectively, The Causes and Factors of Morphogenesis, by Prof. A. Brachet, Recent Work and Views in Astronomy, by Prof. L. Courvoiser; The Urals from the Point of View of Geophysics, Geology, and Mining, by Prof. L. Duparc; Paracelsus in Relation to Modern Thought, by Prof. H. E Sigerist.

SEPTEMBER 3-10

International Union of Geodesy and Geophysics (at Prague).

SEPTEMBER 4-9

INTERNATIONAL CONGRESS OF ZOOLOGY (at Budap. t).

SEPTEMBER 11-17.

International Congress of Physics in Commemoration of the Centenary of Volta (at Como)

### SEPTEMBER 11-18

International Congress of Genetics (at Berlin) In three sections. General Genetics and Cytology, Heredity in Man and Eugenics, Animal and Plant Breeding.

## SEPTEMBER 18-OCTOBER 3.

International Congress of Theoretical and Applied Limnology (at



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# Safety in Mines.1

T is satisfactory to note from the Fifth Annual Report of the Safety in Mines Research Board, just issued, that researches of an important character are being actively pursued, and especially that the Board appears to be taking a wider view of its duties than was at one time the case. It has been pointed out more than once that the tendency of the Research Board was to trust too implicitly to laboratory investigations, and that as an almost necessary consequence many of the researches were confined to chemical or physicochemical problems. What is particularly needed to-day is investigation of mechanical problems. These are of such a nature that their proper investigation can be carried out only in the pit, and laboratory work can do little more than give an indication of the direction in which the researches would need to be prosecuted.

The most fertile cause of underground accidents is still, as it has been for many years, that occasioned by falls of ground, an investigation, sufficiently complete and searching to enable suitable remedies to be suggested, is necessarily a lengthy and wearisome one, and one which can only be carried out underground. It is, therefore, gratifying to observe that investigations of this type are being actively pursued. The results obtained by the dynamometer-prop, the object of which is to measure the actual roof pressures experienced in the mine, will be looked forward to with great interest, though every experienced mmer knows that it is not the amount of pressure only which matters; a roof which weighs heavily, but can be so controlled as to take advantage of that very weighting for the purposes of coal getting, is likely to be a source of much less danger than the roof which presses less heavily, but is apt to break up without warning.

Among the reports of results of investigations issued during the course of the year was an exceedingly valuable one on the East Midland Coalfield, in which the results obtained by steel props were recorded and their more general adoption, at any rate on an experimental scale, was advocated. Such props are attracting considerable attention, and it is to be hoped that the Safety in Mines Research Board will continue to investigate the respective advantages and drawbacks of the different types of props which are being put on

<sup>&</sup>lt;sup>1</sup> Mines Department. Fifth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1926. Pp. 55. (London: H.M. Stationery Office.) 9d. net

the market. It may be noted that the Board has had tests carried out on quartered props, which show that these props are as strong as round props of the same sectional area. It may be doubted whether it was worth while carrying out these tests, seeing that the subject has been fully dealt with in Germany, and the German reports show exactly the same conclusion as has been reached in Great Britain (see Gluckauf, 1926, p 1409). It is, however, some satisfaction to find that the results which have been obtained by the British and German investigators have led to identical conclusions.

Another subject on which the Safety in Mines Research Board is initiating an investigation, is wire ropes, and this may be described as an investigation of first-rate importance. It is true that colliery accidents due to the failure of wire ropes are exceedingly rare, and that they stand almost at the opposite end of the scale to that which accidents from falls of ground occupy. Nevertheless, it may fairly be said that there is no article in common everyday use about which our ignorance is so profound as is the case with the wire rope, and any information concerning wire ropes will be eagerly welcomed. No fault can be found with the objects of the wire rope committee, namely, to discover means of prolonging the life of the rope and of foretelling probabilities of failure: but the method which the committee proposes to adopt, namely, to examine samples cut off from the ends of winding ropes when re-capping takes place, is decidedly open to objection.

Whilst it is a fact that winding ropes very rarely fail at the cappings, it is nevertheless certain that the end of the rope where it enters the capping is liable to much more severe corrosion than any other part of the rope; where ropes are capped by running in white metal, local galvanic action may be expected, and, in any event, this is the point at which acid water, however produced, is most liable to accumulate. On the other hand, the end of the rope is never exposed to bending stresses, which affect every other portion of the rope as it passes over the pit-head pulleys and round the winding drum. These stresses, with the consequent alternation of stress, are bound to have a more or less injurious effect upon the rope, and this effect will be entirely missed by investigations confined to the end of the winding rope. There is no doubt that winding and haulage ropes constitute a vast field for investigation, and it is highly satisfactory to learn that a systematic

attack upon these problems has now been commenced.

Among other researches of importance is one upon the improvement of the lighting efficiency of safety lamps, both electric and flame lamps. and the report certainly suggests that a very considerable measure of success has already been attained. The publication of the full account of this work will be looked forward to with much interest. Researches upon coal dust and firedamn explosions and upon mining explosives are, of course, being steadily continued. Naturally, this aspect of the work is very closely connected with operations at the Buxton Research Station, the official opening of which took place only a few weeks ago. There is no doubt that the geographical position of this station is an immense improvement upon Eskmeals, and the experience gained by the latter station will no doubt have been fully utilised in the design of the new station. so that this may be fully equal to all the work required of it, both as a testing station and as a research station.

Important results may be expected from the electrical researches in progress, the ultimate object of which is to obtain electrical appliances which shall be absolutely safe for use in underground work even in fiery pits. Other subjects which are briefly dealt with in this report are researches on the spontaneous combustion of coal and the investigation of certain defects in mine rescue apparatus, which have been found in practice to cause inconvenience: the report indicates that remedies for these defects will in all probability be forthcoming as the result of these researches. There is a brief reference to the constitution and the work done by the Health Advisory Committee, which has now been brought into closer relationship with the Safety in Mines Research Board by the appointment of Sir Edward Troup as chairman of both.

The report contains two interesting appendices, one being a programme of the researches of the Board which are either in progress or under consideration, and the second a report on the co-operative researches that are being carried on jointly by the United States Bureau of Mines and the Safety in Mines Research Board. It is sincerely to be hoped that this scheme of co-operation will be further extended until it embraces all the researches carried on in all the coal-mining countries of the world upon objects identical with those of the British Safety in Mines Research Board.

# Forestry in India.

The Forests of India By Prof. E. P. Stebbing. In 3 vols. Vol. 3: The Progress of Conservancy and the Development of Research in Forestry, 1901–1925; including Brief Reviews of the Progress of Conservancy in the several Presidencies and Provinces between 1871–1900. Pp. xix+705–122 plates. (London John Lane, The Bodley Head, Ltd., 1926) 42s. net.

THE third and final volume of "The Forests of India" is divided into two parts, the first of which deals with the period 1871–1900. and contains brief descriptions of the main features which affected progress in forestry in the different provinces. The period covered by this section of the book corresponds more or less to a definite stage in the development of Indian forestry. It is the period of reservation and demarcation of an area to be permanently maintained under forest

In reading Part 1 of this volume it is important to realise that India is not homogeneous. Apart from differences in geographical, topographical, and climatic conditions, which result in different forest types and therefore different forest values, the provinces themselves were in varying stages of development and had different histories. Different forms of land tenure existed, and the people differed in local customs and methods of cultivation. Prof Stebbing devotes a separate chapter to each province and gives us an outline of the difficulties to be overcome.

In all countries the history of progress in forestry is the history of the education of the people, and in India a second factor existed, the need for educating the civil authorities. All through we find instances where the latter were antagonistic, or at least unsympathetic, to the Forest Department, and although this may appear to be an unusual feature, it has its explanation in what is described as "a supersensitiveness on the part of the civil authorities on the question of the rights of property" and their reluctance to interfere unnecessarily with local customs. Examples are quoted where this attitude was undoubtedly carried to extremes; but considering the past history of India, this feature was largely unavoidable and its delaying effect may not have been unduly great.

The factors which were primarily responsible for progress were economics, and examples are to be found in most provinces. The visible effects of the destruction of forests on the water supply and erosion, the increasing demand for and the diminishing supply of cheap fuel and timber, were

the things which finally convinced local governments of the need for defining a policy with reference to forest areas.

During the thirty years under review, India was fortunate in having at its disposal the services of three very able Inspectors - General, Brandis, Schlich, and Ribbentrop Prof. Stebbing quotes largely from the reports of these officers, particularly those of Brandis, whose energy and driving powers were amazing.

It is impossible to deal with all the aspects of the developments which are mentioned in Prof. Stebbing's book; but perhaps the most striking fact is the dependence of progress on the close cooperation between the Chief Forest Officer and the local government on one hand, and on the maintenance of friendly relations between the Divisional Forest Officer and the local inhabitants on the other. Where these two conditions exist, the progress of education goes on smoothly and with the least delay.

In other branches of forestry developments were also taking place. In Burma, the United Provinces, and the hill divisions of the Punjab, forests were being worked under regular 'working plans,' and in Ajmer-Merwara and the plains of the Punjab we find the first attempts to re-afforest areas, where the destruction of forests had proceeded too far.

By the end of the last century the progress was such that the area under forest compared favourably with that in other countries in Europe and elsewhere, the general lines of forest policy had been definitely laid down in all provinces, and the forest service was firmly established. Part 1 of this volume is a striking tribute to the first three Inspectors-General.

In Part 2, Prof Stebbing deals with developments between 1901 and 1925, and in the opening chapter he gives a short review on the administration of India during this period. In the following chapter, which is devoted to forest administration, he points out how sylviculture, working plans, utilisation, and research now take precedence over reservation, protection, and forest legislation. On p. 262, while acknowledging the debt owed to the first three German Inspectors-General, he would have us believe that the very rapid progress in recent years dates from the change to English Inspectors-General and, in particular, from the inauguration of the Imperial Research Institute in 1906. If this is to imply that the formation of a research branch is the cause of the rapid development, this is an opinion which will not be accepted by many

forest officers in India, and it is preferable to continue to look upon the progress made as a natural evolution governed by economic factors, such as the growth of Indian industries and the stimulus of the War.

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The figures on p 622 in the chapter on yield and revenue for imports of railway sleepers, which increased in value from less than Rs30,000 in 1919 to nearly Rs40,00,000 in 1923, speak for themselves. The sanction of the large sum of money for the new Research Institute was feasible only on account of the economic need for expansion in research, particularly in the branch of forest economy. We find the same rap d advance in other branches, sylviculture, working plans, and utilisation, the splitting-up of territorial charges and increases in staff, due not to forest research but to the forests becoming economically more important to India.

The chapter on forest research is of particular interest and well illustrated by photographs, which give some idea of the scale on which the new Research Institute is equipped. The author also deals with advances in sylviculture, afforestation, fire-protection, working plans, and exploitation, and in Chap. xiii. discusses forest education and the training of probationers for the Indian Forest Services. In this chapter he expresses opinions which will not find favour with all, particularly on the subject of "training under subsidised German Forest Officers" and on the value of tours on the continent of Europe.

On the question of Indianisation and the future training of Indian probationers, now 75 per cent. of the annual recruitment at Dehra Dun, Prof. Stebbing appears pessimistic In Chapter xvi., on sylviculture, he admits that "at the present day work on as high a plane as anything on the continent of Europe is to be seen in India." He proceeds to qualify this statement by "the proviso that these methods have been so far only applied to a comparatively small area," and gives it as his opinion that "India is not yet in a position to afford as valuable a training ground as exists in Europe, because with few exceptions no Indian forest has yet passed through a whole rotation" Some of those who have had experience in teaching forestry at Dehra Dun and have also re-visited continental forests, will be inclined to think that Prof. Stebbing has been too emphatic on this point. Whatever views are, however, held on this point, it is now the accepted policy of Government to train three-quarters of the future probationers in India, to be followed by a visit to the continent

after three years in a division, and, as is pointed out, it rests with those responsible for the selection of the right type of probationer and for the control of the new training centre, whether the future is to be retrogressive or otherwise.

Prof. Stebbing's book contains a vast amount of information on all aspects of Indian forestry and is essentially a historical record of a department of which India may justly feel proud. It is as a history rather than as a critical work that the book is of value.

Little need be said on the arrangement of the book or the subject matter The author has had to deal with a large subject, covering a period of time during which conditions were changing very rapidly. He must have experienced considerable difficulty in selecting from the mass of official reports and papers those which could most suitably be included to illustrate half a century of forest progress.

Prof. Stebbing is to be congratulated on having compiled a history, which gives so many concrete facts about one of the departments the activities of which are carried on far from the public eye, and on the excellent photographs with which the book is illustrated. In his preface the author expresses the hope that he has been able to show that the Indian Service can take rank with some of the most organised forest services in Europe, and those who read his book will agree that he has achieved his object.

C. E. Simmons.

## Band Spectra.

Bulletin of the National Research Council. Vol. 11, Part 3. No. 57: Molecular Spectra in Gases. Report of the Committee on Radiation in Gases Pp. 358. (Washington, D.C: National Academy of Sciences, 1926.) 4 dollars.

ONE of the most formidable obstacles to the progress of science at the present day is the manner in which it is progressing. The continuous increase in the number of research workers and in the scope of their investigations cannot be a source of unalloyed satisfaction to the carnest seeker after knowledge, who before ever he begins a research must delve long and laboriously in the files of countless periodicals in order to discover just where he should begin. There are abstracts, it is true, but they are seldom adequate; in practice one finds them chiefly useful in facilitating reference to the papers really relevant to one's purpose. From this point of view they are often extremely valuable, but from time to time in the develop-

ment of a subject the need becomes urgent of a pause to review the results obtained and to consolidate the advances made. It is a difficult task, demanding much labour, critical judgment, and breadth of vision. A mere compilation is not enough, for in the study and co-ordination of so many researches numerous problems are bound to arise which call for immediate investigation with the object of removing discrepancies or establishing generalisations Yet the compiler must exercise a nice discrimination in embarking on such researches, for publication cannot be long delayed if the work is to be up-to-date and not unduly littered with "notes added in proof." Obviously, then, it is not a task to be undertaken lightly, but on the other hand, if well done, it should be of mestimable value, not only to the worker in the particular region surveyed but also to those in neighbouring fields as well

The time was undoubtedly ripe for such a review of band spectra In the last ten years a rich harvest of results has been reaped, but scarcely garnered, and the phenomena in question are of such a complex character that no survey could be adequate unless planned on a rather considerable scale. For this reason the National Research Council did wisely in entrusting the task to a committee rather than to an individual. In the pre-- sent case the consequent loss of homogeneity is certainly outweighed by the gain in authoritativeness. There are five contributors · two of them (Kemble and Page) deal with the theoretical side of the subject, and the other three (Colby, Birge, and Loomis) mainly with the experimental, under the headings of infra-red absorption bands, electronic bands, the isotope effect, and fluorescent band spectra.

The second of these sections is by far the largest, comprising in fact more than half the book. This is natural enough, since bands of the electronic type (i e. involving changes of electron configuration) are both the most complex in structure and the most accessible to investigation. Prof. Birge's task must have been an exceedingly difficult one, particularly in view of the rapid progress which has recently been made in the interpretation of optical bands, but he would probably be far from regretting the undertaking, for the researches which presented themselves in the course of the work have had some notable results. For example, they led him to the recognition of the essential similarity between molecular and atomic electron transitions, a conclusion of great importance and Congratulations are due to him upon fruitfulness an extremely valuable piece of work.

The other sections also contain much that is interesting and suggestive. In the account of infra-red absorption bands (Colby) one would have been grateful for a little more information concerning the far infra-red region, so full of difficulty and promise. The section on fluorescent band spectra (Loomis) deals actually with that of iodine only, but the facts described are certainly of sufficient interest to justify the allocation of a whole chapter to them. It seems to the writer that the discussion here is not quite so easily followed as could be wished, but this may be a merely personal difficulty. Chapter v., also by Loomis, is a very useful account of the isotope effects occurring in band spectra. Up to the present these observations have served mainly to confirm band spectrum theory, the isotopic constitution of the elements being already well established, but it is not improbable that they may find wider applications in the future.

The final chapter, by Prof. Kemble, is a masterly survey of certain theoretical aspects of the subject. The account of Hund's recent work on bands will be found particularly valuable, and the section on the Zeeman effect also calls for special mention, providing as it does a basis for discussion and extension of the rather perplexing results already obtained in this connexion

One of the most valuable features of the Report is the systematic notation scheme which has been used throughout. Progress would be greatly facilitated if this were universally adopted by writers on the subject. The volume is admirably produced, and misprints are very few. There is a reference to the "first measurement" of the MgH band  $\lambda5211$  as by Watson and Rudnick (mstead of by Fowler), but this may be nothing more than a slight ambiguity of construction The bibliography, whilst professedly incomplete, is very extensive, but it is a great pity that no index is provided.

## Sex Physiology for the Laity.

Sex in Man and Animals. By John R. Baker.
Pp. xv1 + 175 + 4 plates. (London: George Routledge and Sons, Ltd., 1926.) 7s. 6d. net.

THE need for an inexpensive book on sex addressed to the interested layman and written by a trained biologist has long been recognised. It is true that there are many popular books dealing with this subject, written during recent years by sincere enthusiasts whose chief claim to authorship would appear to be an irresistible yearning to help their fellow-women;

but the extent of the ignorance of established biological fact and the easy disregard of scientific method exhibited by these authors have forced the professional and responsible biologist to accept the task of democratising the knowledge that he possesses. Biology, and especially sex-physiology, is the field in which any and every one exercises his or her opinions. The chemist or physicist can speak of his science without interruption, for in it there still is magic, but let the sex-physiologist speak and his voice is at once drowned in violent controversy. Impressionistic, anecdotal, uncritical doctrine, born of desire and supported by insufficient and inexact observation, denies the logical inferences of dispassionate experimentation, and the people, eager for information and for guidance, are led along the road that leads to disappointment and disillusionment, while the eyes of many still remain blinded by hope.

To the general public sex is still, in spite of the abundant fruits of the last five-and-twenty years of most profitable research, one of the great mysteries. It is high time that the layman should be told that, though as yet all concerning the details of the processes of sex-determination and sex-differentiation is not known, it is the case that the salient and significant features of these processes are already apprehended. The study of the chromosomes and of the internal secretions has revealed the precision and the wonder of the mechanisms concerned, and the advance in knowledge concerning sex has been such that already it is possible to control the expression of certain of its aspects. It is desirable that this knowledge should be placed before the public, whose lives are continually affected in one way or another by one or more of the various manifestations of sexuality; it is desirable that there should be made available a fair statement of current scientific opinion concerning sex; it was high time that some professional biologist, well equipped for the task and with a flair for interpreting scientific terminology into language readily understood by the man in the street and the woman in the home, should place his services at the disposal of those who desire to learn.

Mr. J. R. Baker, provoked by the manifest need for such an exposition, has discussed the facts adequately, frankly, and rationally. In his book, addressed to students of biology and of medicine, the subject matter is well chosen and well arranged and the language is simple. It is written especially for those who look to others for their creed. Among the well-sustained conclusions of many

authorities are dispersed the personal opinions of the author concerning not only the biological but also the anthropological, psychological, and sociological aspects of his subject, and it is not always easy to distinguish between generally accepted facts and reasonable but personal point of view concerning the possible implication of these facts in relation to human affairs The author writes with courage and with competence as one willing to accept the responsibilities of leadership and as one who sees the goal of human endeavour. In his praiseworthy attempt to democratise scientific knowledge he has deliberately avoided meticulous accuracy and any profound consideration of elaborate detail, and so the real significance of the general principles of the subject is not obscured.

Since his teaching cannot be reconciled with the preferences and prejudices of the multitude who dedicate their activities to the dissemination of their own speculative but attractive theories and methods of controlling sex, the author must not expect that his teaching will be as widely followed as it deserves to be. He has, however, the satisfaction of having written a book that must be of great value to any one who, being eager to hear of what is known and of what is reasonable, seeks to sit at the feet of somebody who himself has contributed quite notably to our knowledge of sex

## A Contribution of Science to Religion.

Religion in the Making: Lowell Lectures, 1926.

By Prof. Alfred North Whitehead. Pp. 160.

(Cambridge: At the University Press, 1926).

6s. net.

In the preface to this volume the author refers to the four lectures on religion delivered in King's Chapel, Boston, during February 1926, in which the train of thought which was applied to science in his Lowell Lectures of the previous year ("Science and the Modern World") is here applied to religion. It is stimulating to read this book from the pen of one who can speak with such authority and experience in the realms of mathematics, science, and philosophy.

The work is divided into four chapters, the first of which, "Religion in History," begins with the definition of religion: the theme developed is that religion is solitariness.

"Collective enthusiasms, revivals, institutions, churches, rituals, bibles, codes of behaviour, are the trappings of religion, its passing forms. They may be useful, or harmful; they may be authorita-

tively ordained, or merely temporary expedients. But he end of religion is beyond all this. . . . What should emerge from religion is individual worth of character ''

The emergence of religion is traced and four factors are exhibited—ritual, emotion, belief, rationalisation. The bible is by far the most complete account of the coming of rationalism into religion," and the effect of travelling and trading facilities eventually produce a world-consciousness. The same growth can in essence be traced in India and China. In the last section of this chapter rational religion is described as the wider conscious reaction of men to the universe in which they find themselves. Generality is the salt of religion.

The dogmas of such religions as Christianity and Buddhism, especially with regard to the problem of evil, form the subject of the second chapter, "Religion and Dogma" The contrast is seen in Buddhism as a metaphysic generating a religion, whereas Christianity has always been a religion seeking a metaphysic The life of Christ is not an exhibition of overruling power, its glory is for those who can discern it and not for the world. Its power hes in its absence of force It has the decisiveness of a supreme ideal, and that is why the history of the world divides at this point of time. There are three concepts on which religion is founded, namely, that of the value of an individual for itself, that of the value of the diverse individuals of the world for each other, and lastly, that of the value of the objective world. To the query of value and the attainment of light, comes the answer that religion is world-loyalty. In the greatest of all religious dogmas—What do you mean by 'God' 2—there are three simple renderings of this concept. the first that of the eastern Asiatic concept of an impersonal order, and then the Semitic concept of a definite personal entity, and lastly the pantheistic concept. If the modern world is to find God, it must find Him through love and not through fear; the author emphasises the help of St. John in this direction, rather than the God of vengeance.

The third chapter is metaphysical and leads up to God and the moral order: value and the purpose of God, body, and mind. The fact of the instability of evil is the moral order in the world. The order of the world is no accident; value, beauty, zest of life, peace of life, and the mastery of evil are all bound together, and the religious insight is the grasp of this truth in relation to the completed ideal of harmony, which is God.

Finally, Prof. Whitehead investigates the applica-

tion to religion of a contrast between 'dogmatic' and 'empiric' Again, the divergence of the two traditions of Buddhism and Christianity is traced. with a reference to absolute idealism as a reaction for Buddhist metaphysics on the part of Western Meanwhile science had appeared as a third organised system of thought, and both Christianity and Buddhism, having unduly sheltered themselves from each other, were unable to reveal the requisite flexibility of adaptation Such men as demanded by the rise of science Origen and Erasmus in the Christian Church have, at any rate, recognised the central importance of this adaptability The book closes with references to the nature of God as the complete conceptual realisation of the realm of ideal forms. kingdom of heaven is God God in the world is the perpetual vision of the road which leads to the deeper realities, God upon Whose wisdom all forms of order depend

It is certainly to be hoped that Prof White-head's work will be carefully studied by all who mould current theological opinion H. D. A.

## Our Bookshelf.

Metallurgy of Cast Iron: a Complete Treatise for Engineers, Foundrymen, and Students. By J. E. Hurst. (The Specialists' Series) Pp. xvi+311. (London: Sir Isaac Pitman and Sons, Ltd, 1926) 15s net.

Cast iron has a very limited literature in comparison with steel, and it is only lately that any considerable attention has been given to its scientific study, although isolated workers have attempted from time to time to elucidate its complex problems. The author of this little book has an extensive practical experience of the subject, and has been responsible for several improvements in technical practice. He therefore speaks with authority on matters concerning the foundry. Cupola and moulding practice are not dealt with, and the book is devoted to the chemical and physical characteristics of cast iron in their relation to its use in the foundry. The chemistry is not always correct, but the errors will not mislead the practical reader to any serious extent. The vexed question of the relations between sulphur and manganese deserves more detailed consideration than it receives here, but it is a point on which an author scarcely dares to be dogmatic.

In view of the author's personal experience, it is surprising that so little is said of casting in permanent moulds, especially by the centrifugal process, whilst one also misses a discussion of the various methods now adopted, mainly on the suggestion of German inventors, for obtaining strong and tough irons by heating the mould or by using high casting temperatures, after controlling the chemical composition according to definite

rules Maurer's diagram is open to objection because it does not take into account the varying thickness of castings, but it is a useful guide, and can be modified to give graphical methods of calculating compositions which have proved to be of real use in the foundry, so that it should have been mentioned. The statement concerning viscosity on p 275 is incorrect, and is based on a misunderstanding. The work of Wimmer on the viscosity of molten cast iron was perhaps published too late for inclusion.

C. H. D.

Die Massanalyse Von Dr. J. M. Kolthoff. Unter Mitwirkung von Dr. H. Menzel. Erster Teil: Die theoretischen Grundlagen der Massanalyse. Pp. xii + 254. (Berlm: Julius Springer, 1927.) 10 50 gold marks.

Dr. Kolthoff, of Utrecht, has undertaken in an able manner the task of producing a readable volume dealing with the fundamental principles of volumetric analysis from the point of view of the ionic hypothesis and the law of mass action justification of such a work is that by the application of these principles new methods of analysis may sometimes be deduced by direct rather than by empirical reasoning This is particularly true of reactions involving neutralisation, precipitation, and the formation of complex ions, with which the first part of the book deals. Oxidation processes, on the other hand, are more elusive, since the range of indicators which will detect a definite oxidation - potential is at present somewhat restricted. Attention is directed to the promising results, published by W. M. Clark and others in the U.S. Public Health Reports, on the use of indigosulphonic acids and indophenols. In many cases, however, the disturbing influence of catalysts or of induced by-reactions has to be taken into account

Special attention is also devoted to the theory of indicators, to titration errors and to adsorption phenomena, and a chapter deals with the application of volumetric analysis to organic chemistry. The author is mainly concerned with titrations requiring indicators, but potentiometric methods are briefly described in the last chapter. Tables of useful constants form an appendix and there are numerous references to modern literature in the foot-notes. The German text has been produced in collaboration with Dr. Menzel, and a later volume on the practical application of the methods is promised

Kings of the Hittites By Dr. D. G. Hogarth (The British Academy: The Schweich Lectures, 1924.) Pp. viii + 67. (London: Oxford University Press, 1926.) 6s. net.

Dr. Hogarth has published his Schweich Lectures for 1924 practically in the form in which they were delivered before the British Academy, his reason being that owing to the still imperfectly published state of the results of excavation, the time has not yet come for fuller treatment. In this he has been wise, for, well argued as are his conclusions, his method of treatment in lecture form serves to emphasise their still extremely tentative character.

His kings of the Hittites are those of the Biblical narrative, the rulers of the southern Hittites, to whom reference occurs in the Chronicles of the historic age as holders of States to the north of Palestine in the earlier period of the Jewish monarchy. His purpose has been to illustrate their civilisation and to try to discover their origin and racial character

The evidence upon which Dr Hogarth draws is that imperfectly published, as already stated, from the sites of Zenjirli, Sakjegeuzi, and ('archemish. In discussing the connexion with the Cappadocian Hittite, Dr Hogarth is inclined to see a common origin rather than a direct connexion For this origin he suggests we should look towards the east at the early part of the second millennium B.C. with a leaning towards its identification with the Mitanni. Dr Hogarth by no means minimises our lack of knowledge of this people, and his readers will tully agree as to the need for exploration of the northern area of Mesopotamia, in which their influence was dominant, before we are likely to deal with any approach to finality in this and the other problems which he discusses.

La technique photographique Par L-P Clerc. Préface de Ch. Fabry. In 2 vols. Tome 1. Pp xx+458+2 planches (Paris Paul Montel, 1926) 100 francs les deux vols.

During the last decade or two there have been notable additions to our knowledge of the fundamental facts upon which the practice of photography depends, and some of the problems of twenty years ago have been at least partly solved. Added to this, new needs have arisen, and these have led to the production of new apparatus and new methods of working. It follows that for some few years the want of a modern text-book has been acutely felt by students and their teachers, and it is exactly this want that has been met by M. Clerc We hope that it will not be very long before a similar text-book is produced in English. M. Clerc knows well, from his experience as a teacher, what the student of photography needs, and he has used his knowledge of this and of the subject with great discretion. He has not neglected old facts to make room for new, or so shortly summarised the new as to make the references to them unintelligible. The illustrations are good and well chosen—not from manufacturers' catalogues. The subjects dealt with in the first volume are light and vision, and the apparatus, materials, and processes used in making negatives, leaving the consideration of printing methods for the second volume.

Reptiles and Amphibians their Habits and Adaptations. By Thomas Barbour Pp. xx+125+52 plates. (London: George G. Harrap and Co, Ltd, nd) 10s 6d. net.

This is one of the few books dealing with a neglected branch of natural history, and, though it aims chiefly at interesting a wider public in these much misunderstood animals and is consequently rather of the 'semi-popular' type, it will form a welcome addition to the library of the more serious student. As its author candidly admits, the book lacks contimuity, but gives a very readable, though necessarily incomplete, account of the principal morphological, physiological, and habitudinal modifications which the recent reptiles and amphibians have undergone The whole work is profusely illustrated and, though errors are not entirely absent, the text is essentially sound; one can only therefore regret the occurrence of such a sentence as this: "——and marvellous developments have been attained, though by infinitely slow degrees, to enable these fascinating creatures [snakes] the better to fit into the environmental niche pointed out to each plastic form by the inevitable finger of evolution. It would be interesting to know whether Dr. Barbour really believes that the evolutionary changes an animal has undergone determine the environment it occupies. There is no index

 $\begin{array}{cccc} \textit{Feuchtigkeitsmessung.} & \text{Von Dr} & \text{Hermann Bongards} & \text{Pp. vii} + 322 + 2 \text{ Tafeln} & (\text{Munchen und Berlin}: R Oldenbourg, 1926.)} & 17 \text{ gold marks.} \end{array}$ 

The measurement of the humidity of the air as effected both at an ordinary climatic station and by sounding balloons is not very satisfactory, different methods of estimating evaporation also give different results. So this systematic account of the various processes of measurement that have been developed is of real value not only in a meteorological department, but also to such commercial enterprises as control the quantity of moisture in the air of their factories

After a lucid statement of the physics of gases and vapours, Dr. Bongards groups the processes of measuring humidity according as they are dependent on (a) absorption, (b) saturation, (c) partial condensation of the water vapour, (d) evaporation, and (e) the hygroscopic properties of bodies, he also briefly describes the effect of water vapour on the optical, electrical, and other physical properties of bodies. The comprehensive nature of the treatment may be inferred from the fact that there are 126 diagrams or illustrations of instruments, where advisable their theory is fully discussed and practical advice in their handling is offered. The necessary tables are provided, and full indexes make the volume easy of reference

Permanent Consultative Committee on Official Statistics Guide to Current Official Statistics of the United Kingdom: being a Systematic Survey of the Statistics appearing in all Official Publications issued in 1926 and in certain Selected Publications issued in 1927. Vol 5 (1926) Pp. 273. (London: H. M. Stationery Office, 1927.) 1s. net

THE charge can no longer be made against Government departments that official statistics are hidden in departmental publications of which only the initiated are aware. This valuable volume, issued at a nominal price, is a complete guide to all official statistics published during the past year. It consists of two parts, a subject index and a list of publications arranged under the headings of the departments of issue. The subject index is full and well supplied with cross references. No

worker in need of Government statistics should have any difficulty in tracing what is available by the help of this volume. It is a work of reference which deserves a wide circulation

Données numériques de biologie et de physiologie et chimie végétales Rédigées par Prof. E F. Terroine et par Prof. H Colin (Tables annuelles de constantes et données numériques, Extrait du Volume 5, années 1917 à 1922) Pp. viii + 1537–1675 (Paris Gauthier-Villars et Cie; Cambridge At the University Press, Chicago, Ill: University of Chicago Press, 1926) 56 francs

The present section of this work deals with animal and plant physiology and biochemistry, and consists of tables extracted from papers published during the years 1917-1922, arranged under appropriate headings. Very varied information may be found within its pages Thus weightrelationships, the chemical composition of organisms and their organs and tissue fluids, and the toxicities of drugs are all included. The greater part deals with plant physiology and chemistry, but data on enzymes and the biochemistry of vegetable products are frequently of use to animal physiologists data are given in French, but the table of contents is also given in English, German, and Italian They are compiled from a selected list of about sixty different journals. The work should be useful for quick reference on any particular subject.

Vorlesungen uber landwirtschaftliche Bakteriologie. Von Prof. Dr F Lohnis. Zweite, neubearbeitete Auflage. Pp. viii + 400 + 10 Tafeln. (Berlin: Gebruder Borntraeger, 1926.) 22.50 gold marks.

The first edition of this book was published in 1913 and was regarded as a landmark in the development of agricultural bacteriology. Since that date, although the subject has advanced rapidly, no further edition has appeared, if the small book written in English in collaboration with Prof. Fred of Wisconsin be excepted. The present edition will therefore be welcomed by agricultural investigators, for though retaining the general form of presentation adopted for the original edition, the general results of the last fifteen years' research are incorporated, making the book essentially a modern text-book.

Practical Physics By T. G. Bedford. Pp. x + 425. (London: Longmans, Green and Co., Ltd., 1926) 10s. 6d net.

The course of practical physics described in this book, which is based on manuscript notes used in the Cavendish Laboratory, covers the first year's work of the average student preparing for Part 1 of the Natural Sciences Tripos Most of the experiments are simpler than those performed in the following year, which are unfortunately only partially described in Dr. Searle's text-books. The short introductory section contains valuable general instructions, and the book will be particularly valued by those teachers of physics who have had the privilege of passing through Mr. Bedford's class.

## Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

#### Double Innervation of Striated Muscle.

In the Proceedings of the Anatomical Society of Great Britain and Ireland, just published in the Journal of Anatomy, there is a record (page 498) of a communication by Prof. H. H. Woollard on the innervation of voluntary muscle, which is of unusual importance from its bearing upon a question that is a matter of widespread controversy at the present moment My purpose in directing attention to Dr. moment Woollard's observation, however, is not so much to emphasise its intrinsic significance as to suggest the possibility of an interpretation other than that adumbrated in his preliminary note.

of nerves proceeded to the same muscle fibres. Then the matter began to attract widespread attention, which was largely due to the fact that the attempt was being made to interpret the phenomena of muscle tone in terms of the assumed sympathetic nature of the non-medullated nerves After Prof. Boeke brought his preparations to London in 1921, my colleague J P. Hill suggested to the late Prof. Kulchtsky, who had just come to work in this Department, the desirability of investigating once more the problem that had been the subject of his first original work thirty years earlier.

In 1924, Kulchitsky published the results of this new research on the innervation of the muscles in snakes, in which he demonstrated once more, as Tcheriev and many others had done previously, that the two types of nerves did not pass to the same muscle fibres In other words, he was unable to discover any muscle fibre receiving both kinds of nerve fibres. Hence there emerged a sharp conflict between the results obtained by Bocke on the extrinsic muscles of the eye in mammals and by

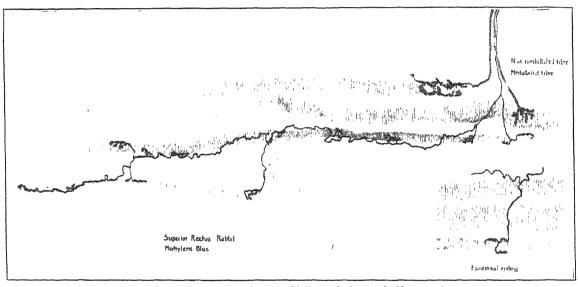


Fig 1.—Dr Woollard's preparation of a rabbit's muscle showing double innervation

For more than fifty years the problem has been discussed whether striated muscle has a double nerve supply (in addition, of course, to the sensory nerves connected with the muscle spindles). Interest in this question has been revived during recent years by the observations of Prof. Boeke, of Utrecht, who claims that each individual muscle fibre is provided with two nerves, a medullated somatic fibre and a non-medullated fibre, which he regards as being

sympathetic in origin.
When, in 1879, Tcheriev directed attention to the fact that the two types of efferent fibres, which twenty years previously Lionel Beale and others had detected in motor nerves, proceeded to different kinds of terminals, the medullated (Beale's "dark-bordered fibres") to the end-plates of Kuehne, and the non-medullated (Beale's "fine pale fibres") to grape-like endings, little attention was paid to the observation. For the opinion was then current that the fine musclefibres—even perhaps the spindles—and their nerves were the embryonic forms of the larger muscle fibres and their medullated nerves (see Koelliker's Crooman Lecture in 1862).

In 1909 and the succeeding years Boeke revived interest in the matter once more. He dissented from the earlier observations by claiming that both kinds Kulchitsky on the subcutaneous muscle of the body in snakes.

During the last three years the question of the innervation of striated muscle has become a matter of acute controversy. Doubt has been thrown upon the existence of non-medullated fibres in motor nerves, and in particular upon the claim that the nonmedullated fibres were derived from the sympathetic; and alternatively the suggestion has been made that the type of innervation found by Kulchitsky in the

snake might not be found in mammals.

Using the methylene blue method of staming, Dr. Woollard (after a very prolonged and laborrous search) has been able to demonstrate (see Fig. 1) in the case of the superior rectus muscle of the rabbit, a double innervation conforming to that described by Kulchitsky in the case of the snake. The rabbit's eye-muscle, like that of the snake's body, consists of two kinds of fibres, coarse and fine. In both cases the coarse fibres are more than double the diameter of the fine fibres, and whereas the coarse fibres receive medullated nerves proceeding to typical end-plates, the finer muscle fibres receive only non-medullated nerves proceeding to grape-like endings, placed epilemmally upon the muscle fibres. Moreover, these endings are disposed in such a way (a number of them being connected with a single nerve fibre widespread on several muscle fibres) as to make it impossible that they could develop into the ordinary end plates. Incidentally, the new observations of Kutchitsky and Woollard that the medullated fibres end hypolemmally and the non-medullated epilemmally, settle once for all the old dispute of sixty years ago (Kuehne, Koelliker, Beale, Margo, Rouget, Naunyn, and Engelmann) as to whether motor nerve fibres did or did not perforate the sarcolemma. As some do and others do not, each group of controversialists had some evidence to support their claims.

The importance of Dr Woollard's demonstration has in the fact that it removes once for all the doubt as to the existence of this type of double innervation in mammals. It also proves that the two types of muscle fibres (and associated nerve fibres) are morphologically distinct one from the other. In his communication, however, Dr. Woollard lays particular emphasis on the fact that he has found this type of double innervation only in the case of the eyemuscles and not in any other part of the body

It is important, however, not to lose a sense of perspective in estimating the meaning of this observation. In 1882, Dr. L. Biemer, of the University of Strasbourg, described (Archiv f. milr Anatomie, Bd. 21) non-medullated nerves ending in the muscles of the tongue and limbs in the riog (see in particular his figures 13 and 20) in precisely the same manner as Dr. Woollard has depicted in the case of the eye-muscles of the rabbit. The coincidence is

most striking and significant.

In view of these facts, especially when taken in conjunction with the difficulty Dr Woollard himself experienced in discovering such endings in the eyemuseles, the failure to obtain satisfactory proof of the presence of such nerve fibres in other mammalian muscles should not be assumed to imply their absence. When they are found so widespread in the muscles of the trunk, limbs, and tongue of amphibia and reptilia and in the ocular muscles of mammals, there is a presumption that one is dealing with a morphological fact that applies to all striated muscles. But it remains for future research to provide conclusive evidence for or against this morphological inference—a problem that Dr. Woollard proposes to investigate in the University of Adelaide.

G. ELLIOT SMITH

University College, London, W.C.1, July 20.

#### Banded Structure in Aluminium and Copper.

IT is a well-established fact that copper, gold and silver, in the native state, exhibit twinning on the octahedral plane

I have recently examined, by means of X-rays, structures in aluminium which resemble lamellar twinning, and a sample of native copper which contained large well-marked lainellar twins. Such structures are always to be found in copper and its alloys, as well as gold and silver, if the metal has been worked and annealed, but are rarely found in cast metals. In aluminium they are rarely met with, although this metal has the same crystal lattice. The orientation in both parts of the 'twin' were determined. Two samples of aluminium were investigated, which showed the same relationship existing between them. These appeared to have one dodecahedral plane in common, but the one could only be derived from the other by turning one upside-down and rotating through an angle of 60°. The plane of junction between the crystals had no relation to the crystal structure of either. This was also the case

in the copper sample. Here there appeared to be no important crystal plane or direction which was common to both parts.

It has always been assumed that the banded structure in these metals represented twinning on the octahedral planes of the crystal, but the examples quoted above show that this is not always so It will, of course, be necessary to compare a number of samples of all the metals mentioned with the view of arriving at any definite conclusions

C F. ELAM

# Acarine Disease and the Muscles of the Honey Bee.

THREE years ago, Dr. Rennie suggested to me that as a part of the research on acarine disease of the honey bee. I should attempt to describe certain pathological appearances in the indirect muscles of the wings, since visible pathological conditions of these muscles are often, but not invariably, associated with acarine disease. The results of the investigation will be published in two parts shortly, and this letter contains the announcement of some of the main conclusions with a plea to biochemists to study these particular muscles of the bee in detail, since they seem to lead to an exceptionally clear path to the cause of contraction of muscle.

Before the pathological appearance of muscle could be accurately described, it was necessary to know the appearance of muscles which were deemed healthy since they were removed from lively bees which showed no signs of any of the known bee diseases. A thorough review of the literature showed that on the histology of the muscles there was no work sufficiently detailed or accurate to be accepted as a basis on which to describe pathological conditions. In fact, the muscles have been greatly neglected, and no description exists which includes, with the appearance of the contractile elements, an account of the nuclei, sarcosomes (reserve 'food' material placed between the contractile elements), innervation, tracheation, attachment to integument, and blood supply of any of the muscles of the bee. The literature on the muscles is very incomplete, scattered, and often inaccurate, and even the somatic musculature has been so neglected that many of the most important muscles are not recognised.

The first part of my paper attempts to deal with the name, function, innervation, tracheation, method of attachment and probable blood supply of every muscle or system of muscles in the three castes of Apis mellifera L. of different races, and it includes histological descriptions of fresh and variously prepared fibres as well as a brief description of their chemical composition and a note on their appearance under polarised light. The course of air through the tracheæ and the physiology of the nervous system in regard to the musculature is also considered. The second part of the paper deals with pathological conditions of the muscles.

Histologically the muscles of the adult bee can be classified as either fibrous or tubular. Fibrous muscle is characterised by its fibre being very easily split into 1000-2000 sarcostyles (fibrils) which are the apparent contractile elements of the muscle. The nuclei are scattered in many rows throughout the thickness of the fibre. Corresponding to the transverse striation of the fibre, there occur layers of semi-fluid substance (sarcosome substance) which seem to be utilised directly during the contraction of the fibre. Fibrous muscle is confined to the four large muscles attached to the walls of the thorax. These muscles are called the indirect muscles of the wings, since by altering the shape of the thorax they raise and lower the wings for

flight. Tubular muscle includes all the other muscles such as somatic, splanchnic, cardiac, doisal diaphragm, ventral diaphragm, and muscles of the reproductive organs. Its fibre is usually a tube with a narrow lumen in which lies a single row of nuclei. The sarcostyles forming the wall of the tube are very firmly bound together and I have not detected sarcosomes between them. There is no unstriped muscle in the bee.

Two different pathological states of fibrous muscle may be associated with a carine disease in bees. They differ in appearance and have their origin in different physiological conditions. They may occur together or singly or be absent in a bee harbouring Acarapis wood Rennie in its trachex

The case in which some muscle fibres degenerate, becoming white, brittle, and unable to contract, is due chiefly if not entirely to the blocking of the first thoracic spiracle(s). The diseased condition of the muscles can be produced experimentally (cf. White, Trans Roy. Soc. Edinburgh, 52, 1921) by artificial blocking of the anterior spiracle(s). The obstruction of the spiracle(s) interferes with the forward direction of the respiratory current of air, and with the obstruction is associated an inhibition or complete arrest of active flight. Young bees seem able to resist the consequences of the loss of flight better than old bees. In the case of 'crawlers' whose tracheæ do not contain many mites, and in the case of active flying bees whose tracheæ contain numbers of mites, it seems to be a matter of how the mites lie in the tracheæ and of many other factors which have to be determined for each bee.

Once flight has stopped the bee ceases to defæcate, thereby setting up many troubles of metabolism in all parts of the body. The fibrous muscles are the seat of very active metabolic changes. A supply of oxygen is essential for long-continued muscular activity, and from the lustology of fibrous muscle it seems legitimate to assume that most of the oxygen would be received from the tracheoles while the rest comes from the blood. The semi-fluid sarcosome substance consists apparently of albumin, glucose, the respiratory pigment, cytochiome, lecithin, and perhaps other lipins and probably various inorganic salts apparently acts as a reserve 'food' substance, passing m and out of the sarcostvles in a perfectly regular manner, depending on their state of contraction, and it is also very intimately united with the tracheoles. Presumably it is being constantly replenished by the blood and tracheoles in a healthy bee. Should the blood be loaded with toxins as the result of the non-defæcation of the bee, it seems probable that it would deposit some of its poison in the food-store for the muscle fibres, and this would be extra harmful if the fibres were already suffering from an impoverished oxygen supply from the tracheoles.

The waste products of metabolism resulting from muscular contraction can only pass away via the blood and tracheæ. During acarine disease the lumen of the tracheæ is liable to become obstructed, and if so a path for vital reactions is closed. When this happens the sarcosomes lose their orderly arrangement and become very much enlarged by coalescence with one another, probably because they are chemically very unstable and require the balance which is supplied only by the properly functioning tracheæ. Once the stability of the sarcosomes is affected, the contractile elements depending on them are thrown out of action, and so the muscle fibre suffers a change leading to death if the obstruction of the tracheæ is continued for long.

The other case, in which portions of muscle fibres assume a brown or black colour, seems the effect of

oxidation of a substance in the blood, probably dioxyphenylalanme, which turns black in the presence of oxygen, an alkaline oxidase, and water. The dark pigmentary colour of the bee, and probably also the blackening of the tracher in acarine disease, are probably due to the same substance. The darkening of the muscle, ie deposition of pigment in a fibre, does not seem to affect the contractibility of the fibre or to interfere greatly with its normal metabolism. It is the normal reaction to direct injury of normal tissue bathed with blood, and it can be produced experimentally with case. It assumes its deepest colour where apparently there is most oxygen, i e. near a trachea. The same holds true when it is associated with acarine disease, when presumably it is the result of mechanical mjury to the muscles by the mite In acarine disease the darkening very rarely occurs alone Almost always it is near a trachea in the centre of a fibre or part of a fibre which is degenerating and becoming whitish and brittle

GUY D. MORISON

Marischal College, University of Aberdeen.

# Discovery of Stone Implements of Lower Palæolithic Age in Ireland.

For many years past, as is well known, the prevailing opinion among archæologists has been that no traces of palæolithic man have come to light in Ireland; and it has been generally believed that he never lived in that country. During recent visits to Rosses Point, Sligo, I had considerable opportunities of examining the coast sections and the beach material



Fig. 1—Three views of large racloir in limestone from Rosses Point, Sligo.

there exposed, and I have been so fortunate as to discover a series of implements, and flakes, in limestone which, by their provenance and forms, I do not hesitate to refer to the Lower Palæolithic (Early Mousterian) period.

On the western, or seaward, side of the middle limestone promontory at Rosses Point, which separates Drumchiff and Sligo Bays, there are to be seen the remains of a rock-shelter. The shelter has a south-



Fig 2 —Fan-shaped ractor in limestone from Rosses Point, Sligo

westerly aspect, and now occupies an area of about 47 feet by 9 feet. The floor is 5 feet above present high-water mark, whilst the roof is 8 feet above. These measurements are taken at the back of the shelter. Covering what is left of the roof is an Early Neolithic raised-beach consisting of powdered shelts to a depth of I foot. The outer margin of this beach rests in a hollow in the Boulder Clay which formerly

covered a portion of the headland, but was partially eroded in Early Neolithic times. Under the large blocks of rock, evidently fallen from the roof of the shelter, I found more than 100 unrolled flakes and flake implements made of limestone. Some of these flakes are very large and weigh so much as 36 lb. The artefacts discovered may be classified as follows:

Levallois-like flakes. Side racloirs (Fig. 1). Fan-shaped racloirs (Fig. 2). Choppers. Ovate hand-axes. Pointed hand-axes (Fig. 3). Square-ended scrapers.

A little more than a mile to the south of the abovementioned site, upon Coney Island, the remains of a large cave may be seen. It is now 50 feet wide, 4 feet high, and 6 feet from back to front The

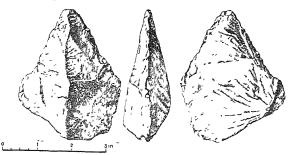


Fig. 3 —Massive hand-ave in limestone from Rosses Point Sligo

cave faces north-east and its floor is below the level of high tides, with the result that the contents have been drifted out and along the coast for a distance of half a mile, and are now found there upon the beach. These implements, two of which are remarkable examples of Lower Palæolithic workmanship, are, as would be expected, rolled, and exhibit on their surfaces marks due to collision with other stones.

In addition to an examination of the sites at Rosses Point and at Coney Island, I have carried out a close investigation of the sections of Boulder Clay visible upon the coast, and at Ballyconnell, situated

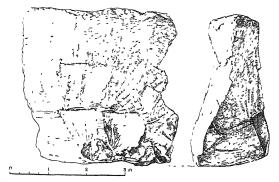


FIG. 4.—Prepared core in limestone found in situ in Boulder Clay at a depth of 39 ft from the surface at Ballyconnell, Sligo.

5 miles to the north-west of Rosses Point, I discovered, in situ, at a depth of 39 feet from the surface of the ground and embedded in Boulder Clay, a core, with facetting upon both platforms, and a massive flake used as a hollow-scraper, formed of limestone. One of these specimens (Fig. 4) weighs 12 lb., and exhibits glacial striæ on both faces. The occurrence of the artefacts in Boulder Clay affords conclusive evidence of their antiquity, and, apart from any other circum-

stances, makes it in the highest degree probable that the other specimens of the same type from Rosses Point and Coney Island are older than the Boulder Clay represented at Ballyconnell. The section at this place shows the following strata:

> Landwash, 4 feet. Boulder Clay, 35 feet. HORIZON OF FLAKE IMPLEMENTS Boulder Clay, 7 mches. Middle Limestone.

From the researches  $\boldsymbol{I}$  have carried out it seems clear that the specimens:

 $(\alpha)$  are of undoubtedly human origin, and of Lower Paleolithic (Early Mousterian) types,

(b) are older than a deposit of Boulder Clay present upon the Sligo coast; and

(c) have a considerable distribution, and are not confined to one site only.

The surfaces of the artefacts exhibit a different colour from the freshly broken limestone, and some show patches of what appears to be a very definite patination. The material from which the specimens are made has a well-marked conchoidal fracture, and was very skilfully flaked by the palæolithic hunters of Sligo.

I hope in the near future to publish a full and illustrated account of my discovery.

J. P. T. BURCHELL.

30 Southwick Street, Hyde Park, W.2.

I have examined a large series of the remarkable specimens collected by Mr. Burchell in Sligo, Ireland, and, at his request, I add a few lines to the preliminary note on his discovery. In the first place, I have no doubt that these specimens were flaked by man, and, secondly, that their forms are such as were made in Lower Palæolithic, Early Mousterian, times. Though I have not yet visited the sites where Mr. Burchell has worked in Ireland, and am thus not able to testify, from personal observation, as to the soundness of the geological evidence upon which he relies, yet I believe, after a study of his carefully recorded details of the provenance of the specimens he has found, and an examination of one of three artefacts discovered by him embedded, at a depth of 39 feet, in Boulder Clay at Ballyconnell, that this evidence is satisfactory. Many of the Sligo implements are of impressive size and appearance, and I hope it may be possible, in view of the manifest importance of Mr Burchell's discovery, to publish accurate wash-drawings of these, J. REID MOIR. of the natural size.

One House, Ipswich.

## Evolution: Emergent and Resultant.

In adhering to the position already outlined (Nature, July 16, p. 81), I should like to suggest further that there is a fundamental distinction between what happens to be inferable "on the basis of existing knowledge," and what is not inferable under any intellectual conditions whatsoever. (In the present connexion 'inferable' is more relevant than 'deducible,' since not deduction alone, but all forms of inference, are legitimate.) What was not inferable by their predecessors, for example, was inferred by Newton and Darwin themselves. But it is often argued that the existence and qualities of certain "integral wholes" can never be inferred and explained from "the most complete knowledge"—not merely "existing knowledge"—about their constituents possessed by any finite mind whatever. (I exclude infinite mind in order to limit the discussion.)

This position appears to me to be quite unjustified

by the essential tendencies of modern research. As soon as knowledge ceases to be merely elementary (and with all its limitations, this at least is true of modern knowledge), its realised content yields plain indications of the nature, scope, and potentiality of knowledge as knowledge. We begin to understand both what knowledge is capable of doing and also why it possesses this capacity, even while we realise the drastic limits of its immediate advance, nor can it be objected that this issue is not strictly scientific, since epistemology stands on precisely the same footing as physics, how minds know, in other words, is fully as scientific a problem as how bodies move We are concerned, therefore, not only with the established content of knowledge, but also, and to a still more important degree, with the intrinsic nature of knowledge.

From this point of view, Prof Lloyd Morgan's criterion seems to afford a merely relative distinction between emergents and resultants; since, as knowledge expands, the first must obviously fall within the second. We require, therefore, as he suggests, some method of regarding certain "integral wholes as being at the same moment (a) inferable in principle and (b) unprecedented in character, and so undeniably emergent I venture to suggest that this situation resolves itself into the evolution of existentially new syntheses whose nature, and the nature of whose elements, are fully knowable (in principle) by finite minds, which can also infer that such syntheses will necessarily and causally precede processes hitherto non-existent Television exemplifies this situation on a relatively simple scale, and the immortal drama of the future on a much more complex scale; and in this connexion two further essential features must be considered The first is the degree of complexity presented by the structure of the synthesis; the second, which is obviously closely associated with the first, is the degree of contrast with earlier syntheses. When the contrast is slight, as in the summations mentioned by Prof. Lloyd Morgan, emergence scarcely

Thus both television and the future drama are emergent, because both, taken in their entirety, are unprecedented, despite their widely differing forms At the same time, each is the final culmination of antecedent tendencies, which are never (in principle) indiscernible as data for inference; whether they can be so employed or not depends on the intellectual capacity of the investigator. In principle, therefore, every "integral whole" and all its effects are inferable and, consequently, also resultant But if, like finite mind at its first origin, any had never pre-existed, it would equally be emergent; while if, like the earth's future revolutions, any had pre-existed, then it would be not emergent but resultant only. Emergence thus becomes an additional characteristic, or quality of a higher order, the differentia of which is marked, or even absolute, existential novelty. Every emergent arises like Aphrodite from the foam, unparalleled—once again the element of contrast—but not therefore inexplicable and non-inferable. If, then (as a final concrete example), the biochemical synthesis of living organisms is effected within the next few decades (as is by no means impossible), these should, in my opinion, be regarded as emergent for two reasons: (a) because they would share the emergent quality of life as such; (b) because, as artificial, they would be unprecedented; while (c) they would also be completely explicable and inferable from man's actual precedent knowledge.

J. E. TURNER.

University of Liverpool, July 23.

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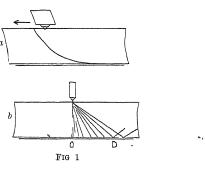
## Diamond-glass Fluorescence.

That fluorescence may result when a glazier's diamond is drawn over the surface of a pane of glass was shown by Foley many years ago (Science, N.S., vol. 13, No 332, May 10, 1901). This phenomenon may be studied indirectly in two ways. (a) by ruling with a diamond on the back of a photographic plate, (b) by placing a clear glass plate on the film side and ruling on that. In either case on development a distinct darkened band will appear (if there was fluorescence) the width of which depends on the thickness of the glass plate that was ruled and the angle of total reflection. In (a) the affected portion of the film is of course on the under side next to the glass, and the development consequently is considerably slower than in (b), where the exposure is on the tront side of the film. The angle of total reflection in either case is given by the relation

$$d=2t \tan \theta$$
,

where t is the thickness of the glass plate and d the width of the band.

The phenomenon that attracted my attention, and prompted this note, may be briefly described as



Recently, while cutting photographic plates into strips for a special purpose, it was noticed that the bands for the particular diamond used were oftentimes only half the width of those described by Foley, also that if the bands did appear on both sides they were generally of unequal density; and, moreover, one or the other of the bands were occasionally found to be discontinuous, or even both sides disappeared, only farther on to have reappeared again. It was observed that a full-width band may result when the 'cut' is a scratch, or even when the diamond glides over the surface without leaving a trace. In every instance when fluorescence was produced under conditions other than those when the diamond 'rings clear,' the resulting band was full width. In other words, a new diamond that is perfect in its cutting qualities may, when fluorescence accompanies the cut, produce a half band, or a full-width band in which one-half is more dense than the other. Why this results may be explained by reference to

Fig 1.

In Fig. 1, a, the diamond is shown held at the cutting angle and drawn to the left. The resulting cut or crevasse opens in advance of the cutting edge, and ultimately may open up entirely through the plate, as shown. This crevasse forms a totally reflecting surface confining the light emanating from the point of contact (which is at the side of the diamond and not at its tip) wholly on one side, as shown in Fig. 1, b. The band begins abruptly at O, increasing in density to the right, and ends abruptly when the critical angle is reached at D.

If the other side of the diamond produces fluorescence also, then the total width of the band is 20D.

However, this half, as stated before, may differ widely in density from the first. If the diamond is a poor one and scratches or merely rubs the glass surface, the resulting band, if present at all, is always of width 20D

Others may also have observed the one-sidedness of this phenomenon when using a new glazier's diamond.

CHAS. T. KNIPP.

Cavendish Laboratory, Cambridge, July 20

## Atmospheric Electricity.

IN NATURE of Mar. 5 (Suppt, p. 6), Dr. Chree gave an excellent review of my book." Die elektrische Leitfahigkeit der Atmosphare und ihre Ursachen." (Vieweg und Sohn, Braumschweig, 1926), which will appear in English within this year. I am much pleased to see that Dr. Chree, who is an authority of world-wide reputation in atmospheric electricity, finds my book valuable and not inferior to the recent French monographs on atmospheric electricity by the late B. Chauveau and by Dr. Mathias and his co-workers.

Nevertheless, I should like to make a few comments upon Dr Chree's review in order to remove one or two misunderstandings. Dr. Chree seems to object to my use of the term "Kennelly-Heaviside-layer" instead of "Heaviside-layer." I thought I was justified in using the first expression because in the American journal Science (1925) it was stated that Kennelly was the first to postulate the existence of the conductive layer in the upper atmosphere, and not Heaviside. If in this I am wrong, I will gladly alter this in the English edition of my book

At the end of his review Dr Chree says . "Dr. Hess does not, however, seem to notice that if the somewhat serious defect in the Ebert apparatus, which he accepts as proved by Prof. Swann, really exists, then much of the information which appears in the present book and elsewhere respecting negative ions must require correction." To this I must add that in choosing the numerical data on ionic numbers for my book I tried to select only those taken in places where the apparatus was well screened from the electric field of the atmosphere Observations taken under these conditions are fortunately more numerous than those unscreened in the open air, and therefore I believe that the data given in my book require no correction whatever From my own experience I should think that the effect of the earth's field disclosed by Swann was overestimated in some cases, and that the distribution of ions, as found in electrically well-screened places (under the leaves of trees, m open windows, verandahs, etc ), is not very different V. F. HESS. from that in the open air

University of Graz.

Austria

WITH regard to the 'conducting layer,' my objection was to associating it with the name of either Heaviside or Kennelly. It would probably be best, as in the case of the 'penetrating radiation,' to attach no personal name, but if a name is to be attached, the claims of Balfour Stewart, as I have already explained in the columns of Nature, seem to me to come first.

With regard to results from the Ebert apparatus, I noticed no explicit statement in the text that only those stations had been included where the apparatus was specially sheltered, and in at least one or two of the cases mentioned I had reason to believe that the contrary was the case. I am personally inclined to share the doubt now expressed by Prof. Hess whether

Prof. Swann's unfavourable conclusions are in actual practice fully justified. Some experiments, in fact, made at Kew Observatory by Mr E H. Nichols ("Terrestrial Magnetism and Atmospheric Electricity," 1916, p 87) did not confirm Prof. Swann's conclusions But there seems no reference to these in Prof. Hess's book, and I had supposed him to accept Prof. Swann's conclusions without reserve. My own view is that an independent investigation into the conditions under which the use of the Ebert apparatus is wholly satisfactory would be useful. I am glad to hear that we may expect an English version of Prof. Hess's valuable book.

### The Depth to which Whales Descend.

When a whale is attacked, it usually attempts to escape by 'sounding' or going vertically down; the rope it takes out on these occasions is a good measure of the depth it descends to, and the attacking boat, owing to the strain on the line, an indicator of its position under water

The Right-whales appear to descend to greater depths than the Fin-whales, and on this account to be more easily captured. When the Greenland whale is attacked, it usually leaves the surface and descends immediately; it takes out rope very quickly and soon reaches a great depth. After a time it reappears near where it went down in an exhausted condition and is easily captured. Large ones appear to descend to a depth of 700-800 fathoms and remain under water nearly an hour. Sometimes the Greenland whale dies at a depth of 800 fathoms, and sometimes, as related by Scoresby, if the depth of the water is not sufficiently great, it strikes the bottom while descending and kills itself in this way; in both cases it has to be hauled up dead

It is only when it is attacked in very deep water with the hand or simple gun harpoon, as in former days, that the Greenland whale descends to a great depth and that the boats engaging in its capture require to carry a very long line; in water of moderate depth a much shorter one suffices. This fact is surely in itself a sufficient answer to those who, on purely theoretical grounds, deny that whales can descend to great depths.

The blubber of whales appears to be related in some way to the depths to which they descend. In the Greenland whale, for example, it is very much thicker than in its congener the narwhal; perhaps its great thickness enables it to withstand the pressure at great depths?

R. W. GRAY.

## Ophion luteus.

The shrill sound of this fly is here a sure nocturnal herald of the Dog Days. Nearly six years ago I described in Nature (Nov. 10 and Dec. 1, 1921) how some members of my household had been stung by the fly; but it was not until last night that I was favoured by its attention. The weather being very sultry, I was sleeping under a single sheet when I was awakened by a sharp stab in my thigh. Clapping a hand on the place, I missed the intruder; but immediately after was stung on the left arm and this time caught Ophion luteus

The incident would not be worth recording were it not that it puzzles one to understand what can be the motive in this fly, when not molested, in thrusting its ovipositor into a human being. It would be interesting to hear whether other persons have received similar attention from this or any other species of Ichneumonidæ.

Herbert Maxwell.

Monreith, Whauphill, Wigtownshire, Aug. 7.

## Some Colouring Agents in Glasses and Glazes.1

By Sir Herbert Jackson, K B E., F R.S,

Director of Research, British Scientific Instrument Research Association

THE colouring agents of glasses and glazes are very many; moreover, several of these agents can impart colour to glasses or glazes in what may be described as different ways. An explanation which would include all our present knowledge of the behaviour of any one of them would occupy a long time. I have chosen two colouring materials, copper and iron, and propose to deal with some of the effects which can be produced by them and their compounds. I should like also to make a few remarks on certain effects which can be produced by radiations such as ultraviolet light, X-rays, and gamma-rays from radioactive materials

I have chosen copper and iron because, in their various modes of action as colouring agents in glasses and glazes, they illustrate fairly completely the manner in which most of the materials used in this connexion behave. For present purposes I will not draw any definite distinction between glasses and glazes, but will use the terms somewhat

indiscriminately.

Copper can be introduced into a glass or glaze so as to produce reds, browns, yellows, greens, blues, purples, and black. In some instances the colours can be well seen by transmitted light; in others the material is too opaque to show the colour except by reflected light. These various effects are produced by compounds of copper or by metallic copper itself. Of the compounds of copper, attention will be especially devoted to the two oxides of copper, cuprous oxide and cupric oxide. Cuprous oxide is the colouring agent in the brilliant scarlet Egyptian glass, specimens of which appear to be correctly attributed to at least as far back as the XVIII. Dynasty and up to Roman Egyptian times. It would appear from the absence of any specimens attributable to more recent times that the knowledge of how to produce this glass successfully was then lost.

Microscopic examination of a specimen of the scarlet Egyptian glass given to me some years ago by Prof. J. N. Collie, and of other specimens given to me more recently by Mr. Horace Beck, showed that the colour was due to small crystals of cuprous oxide. Chemical examination of the glass itself revealed that it was an ordinary lead glass containing about 30 per cent. of lead oxide, and the quantity of cuprous oxide varied from about 8 per cent. to 10 per cent. Based on this information the glass was successfully made after a few trials. During those trials yellow crystals were often observed in parts of the glass, and recently Mr. Horace Beck provided me with an orange yellow bead found at Faversham, in Kent, the colouring matter of which was again identified as cuprous oxide, but mainly in the yellow form. The red form of cuprous oxide is the better-known form, and is produced when copper is heated in a

<sup>1</sup> Discourse delivered before the Royal Institution on Friday, Mar. 4.

limited supply of air; it can generally be well seen on the underside of the black scale detached from a piece of metallic copper which has been heated for a short time to a high temperature in air and then kept at a lower temperature for some time.

A ready method of producing the red oxide is to add a solution of copper sulphate to a solution of glucose and then to add caustic potash to the mixture. On heating the clear blue solution so obtained, reduction of cupric oxide by glucose occurs, with consequent precipitation of red cuprous oxide. At the first stage of heating it is generally possible to notice the formation of a yellow precipitate mingled with the red, these colours can be better shown by using Fehling's solution, which is made up from copper sulphate, Rochelle salt, and caustic potash, and is a clear blue solution. If a small quantity of the solution of glucose be poured into a large quantity of boiling Fehling solution the red oxide is formed If a small quantity of Fehling solution be added to a large volume of boiling solution of glucose, the yellow form is produced, and is permanent in the sense that it may become rather more orange in tint but does not reach the red stage.

Without going into the doubtful composition of this yellow form, in respect of the extent to which it may be considered hydrated, it may be remarked that if it is heated out of contact with air the yellow form persists, and is apparently completely freed from water at a temperature of about 350° C. The difficulty of making any statement about the temperature at which the yellow form can exist in glass will be appreciated if a short description is given of the behaviour of cuprous oxide glass

during its preparation

If the proportion of cuprous oxide introduced into the glass be about 8 per cent., the whole of it dissolves in the glass at the temperature of 1000° C. at which the glass is made. If the glass be quickly chilled from this temperature, no colour, except the almost unavoidable green colour due to oxidation of part of the copper, will be seen; the glass is a nearly colourless transparent one. On reheating this glass it is possible to produce, according to the temperature to which the glass is raised and the length of time during which it is heated, comparatively large crystals or aggregations of crystals of red cuprous oxide, smaller crystals of the same form, or particles so small as not to be recognised as crystals under the microscope Along with these are frequently obtained definite crystals of the yellow form, clouds of yellow particles, and, if the re-heating be gentle, the particles of yellow cuprous oxide are so small as to be unrevealable by the microscope, and what is obtained is a clear yellow transparent glass. Here, then, from two forms of one and the same oxide of copper, we have a range of colours associated with the proportions in which

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the two forms are mixed in the glass and with the size of their particles What is the inner nature of the difference between the red and yellow forms which may account for their difference in colour is vet to be made out.

Much ancient Egyptian glass does not contain lead, but is mainly of the composition of an ordinary window glass—that is to say, its principal ingredients are silica, lime, soda, with varying quantities of potash, magnesia, and alumina. It has not been found possible to make the brilliant scarlet cuprous oxide glass satisfactorily in a glass of this composition The temperature required for the proper making of such a glass is too high for the persistence of the scarlet colour, and the resulting glass is of a brown or brownish-red colour. A scarlet coloured glass of the common soda-lime type could be made if the composition of the glass were so chosen that its fusing point was as low as that of the lead glass which the Egyptians used. If the Egyptians ever did make such a glass, it would have been so unstable that it could scarcely be supposed any specimens of it would have persisted to the present day.

Ancient brown glass of the soda-lime type just referred to appears to have been very widely distributed. Recently I have been given some beads of this glass which, I am informed, work up through the sand on the coast of Zanzıbar. Whatever attribution is given to the various specimens, they all seem to be very similar in composition and to depend for their colour upon the presence in the glass of minute particles of metallic copper. Whether the production of this brown or brownishred glass preceded that of the scarlet glass is a question which cannot be dealt with here. It is worth while, however, to refer to one property of cuprous oxide. This oxide does not form salts with acids except with the halogen acids: hydrofluoric, hydrochloric, hydrobromic, and hydriodic. With the oxygen-containing acids, if it re-acts with them, metallic copper is produced along with a cupric salt of the acid. With sulphuric acid this change takes place at the ordinary temperature; with a weaker acid, like acetic acid, the action is very slow unless the temperature is raised.

Taking these reactions as analogous to what may occur in a glass, and considering silica as a weak acid, it will be understood that if the temperature of a glass, either the lead glass or the soda-lime glass, be raised high enough, the result will be the production of metallic copper dispersed through a greenish cupric oxide glass. If the percentage of cuprous oxide used were high, about that used for the scarlet glass, there would be sufficient green to make the red of copper look, by reflected light, distinctly brown. With less copper present the colour would get nearer to a red, and it will be easily understood how, by using progressively less and less copper it would be possible to arrive at a glass resembling the wellknown red glass which owes its colour to particles of copper so finely comminuted as to render the glass quite transparent to the eye. The transparent red copper glass and the brilliant sang-de-bæuf

Chinese glazes are made under conditions which tend to reduce any cupric oxide which may be formed, so that the resulting glass is not rendered dingy by a green tint, due to dissolved cupric oxide, marring the brilliant red due to the dispersed metallic copper. It should be added that for this brilliant glass so little copper is used (it is in the neighbourhood of 05 per cent) that any colour from cupric oxide which would arise from such a change as is mentioned above under the action of silica would be so pale as to have practically no effect on the brilliance of the red due to the

dispersed copper.

Here, then, we have again considerable variations in the appearance of the glass dependent upon the size of the particles of the colouring agent dispersed through it, and this is made evident when thin pieces from different portions of glaze from one and the same Chinese sang-de-bouf vase are examined by transmitted light Under the microscope, for example, some pieces are distinctly red, others are purple, others again are blue, and others look like neutral coloured glass. Closer study shows that in the most brilliant red portions no particles can be seen by the microscope. In some of the less transparent red pieces, particles are revealed either by a cloudiness or as discrete particles. In the purples these particles are larger, and in the blues they are still more marked, while in the neutral colours the particles are generally seen less closely packed but distinctly larger in size.

The colours produced by cupric oxide in glasses and glazes need not be dealt with in detail, as there is much common knowledge about these. One or two points not in common knowledge may, however, be emphasised. In a glass of the same composition, cupric oxide may give a very marked blue colour if the glass is made at a comparatively low temperature (1000° C. to 1100° C.); whereas with the same concentration of copper and the same glass made at a higher temperature, about 1300° C., for example, there is a very marked green shade in the blue. It is worth pointing out that the blue low-temperature glass is green while hot.

It would lead us into too much detail to do more than direct attention to the possible analogies between the action of water in solutions of cupric salts and the action of the oxides of the alkali metals in glasses coloured by cupric oxide. The change from blue to green just mentioned in the case of the low-temperature cupric oxide glass calls to mind the fact that a green solution of cupric chloride, which becomes blue when sufficient water has been added, becomes green again on heating it. A study of the changes of colour which can be produced in aqueous solutions and salts, and of the methods of modifying these colours, has been of great assistance to me in shortening the experimental work necessary to arrive at the compositions of a number of glasses in which it was desired to produce certain colours either with copper or other colouring agents.

As an example of the change of colour effected by adding water to a salt, copper sulphate may be mentioned. This salt, in its anhydrous condition or with only one molecule of water, is colourless Crystals containing five molecules of water are the ordinary blue copper sulphate crystals, and the solution of these in water is blue If we take boric anhydride and an oxide of an alkali metal as analogous to sulphuric acid and water, a very similar story can be told A small quantity of cupric oxide does not dissolve in fused boric anhydride, but forms a white borate which is dispersed through the fused mass The addition of an alkalı will bring about solution and give a clear blue transparent glassy mass. The most striking example is to take boric anhydride and the alkalı lithium oxide in, say, three different proportions, such as one molecule of lithium oxide to one, four, and ten of borne anhydride With 05 per cent of cupric oxide the first is a fine deep blue, the second is a paler blue, the third is still paler; and if the proportion of alkali oxide be lowered until there is only just sufficient to bring about complete solution of the cupric oxide in the mass, there is but little colour to be seen at all.

With many glasses made at a high temperature, cupric oxide gives an olive-green colour. Without going so far as to say that the dusky shade in the green is invariably due to some reduction of the cupric oxide to the lower oxide of copper, there is evidence of this in certain instances which I have come across. To take one: in making trials for a glass which was intended to be of a green colour with only a slight tinge of olive in it, and of a sufficiently light shade to enable the light of a candle flame to be seen through a 1-inch thickness of the glass, the furnace conditions happened to change on one occasion so that the glass was exposed to a reducing atmosphere. The resulting glass was so black that a bright June sun was invisible through a piece of the glass one-fortieth of an inch thick. Such a state of affairs might be considered to come about by the glass being a mixture of red copper glass with a green cupric oxide glass, through which mixture but little light could be transmitted. Now red glass owing its colour to finely dispersed metallic copper is rendered colourless by fusing it and quickly chilling it. The black glass referred to might therefore be expected to become green if fused and quickly chilled, but it did not change from its intense black colour. This just gives a hint of the possibility of a cuproso-cupric compound being present in the glass analogous to, though not so definite as, ferroso-ferric oxide, the well-known black iron scale.

Again, an analogy with solutions helps a little. If to a colourless solution of cuprous chloride in hydrochloric acid there be added a transparent green solution of cupric chloride, the mixture turns black. Although dusky greens and the black glass just referred to might be accounted for by varying mixtures of red and green glass, the colour of this solution could scarcely be accounted for in the same way. Moreover, in experimenting with red copper glasses, and studying the way in which the red colour can be prevented from developing by sudden chilling and can be produced by subsequent

heating, I have repeatedly noticed that, instead of obtaining a clear colourless glass in bulbs made from the red glass and quickly chilled, the bulb has been sometimes of a dusky hue and sometimes of a definite neutral tint As no other colouring agent but copper was present in these glasses, I am inclined to attribute the neutral shade to a cuproso-cupric compound which is stable in the glass and is analogous to the compound formed when the cuprous and cupric chloride solutions are mixed, rather than to a physical mixture of

red and green glasses

I must not deal further with cupric oxide glasses except to mention that, unlike cuprous oxide glasses, copper glasses and many other coloured glasses, such as gold glasses, selenium glasses, cadmium sulphide glasses, and opal glasses, cupric oxide glasses cannot be rendered colourless by sudden chilling, nor, indeed, can the tint of these glasses be modified to any noticeable extent in An attempt to explain this difference, which seems to divide colouring agents generally into two classes, would involve a very lengthy account of the various phenomena which have been observed, and would, moreover, be to a considerable extent little more than a re-statement of facts which would involve differentiation between the meanings of such terms as 'solution,' 'chemical combination,' and 'dispersion,' and would lead to much argument I must content myself with this short and incomplete account of the modes of behaviour of copper and its oxides in glasses and glazes.

Passing on now to iron, there are colours produced by ferric oxide, ferroso-ferric oxide and ferrous oxide, but I do not know of any glass or any material which could be called glassy which owes its colour to metallic iron in a fine state of dispersion. Starting in the first place with ferrous oxide, which gives the well-known green colour to glass of the nature of window glass, I need only point out that this colour is considerably modified by the composition of the glass, and without going into a number of details I will mention the way in which this tint is modified by the presence in the glass of zinc oxide or magnesium oxide The former intensifies the colour produced by any given amount of ferrous oxide and changes the usual green into almost a blue. A similar change occurs with magnesium oxide, but the intensification of the colour is less marked Among the alkalis, lithium oxide also tends to give a bluish tint to glasses containing ferrous iron A notable example of this is seen in an early Chinese glaze which, through the kindness of Mr. G Eumorfopoulos, I had the opportunity of examining. The thunner parts of this glaze are practically colourless, but the thicker parts have a beautiful blue tint An examination of the glaze showed that it was for such glazes unusually rich both in lithium oxide and in magnesium, and the colouring material was identified as iron. If the Chinese workers had substituted zinc oxide for the magnesium oxide in their glaze mixture, the colour would have been very much more marked.

(To be continued.)

## The Control of Insect Pests by Means of Parasites.

By Dr. S. A. NEAVE.

In recent years agriculture in its broadest sense has received a powerful stimulus throughout the British Empire owing to the tremendous growth of the demand for vegetable and animal products of all sorts, especially in the more densely populated countries. In consequence, more and more attention has been directed to the insect and other pests of crops and domestic animals, and some recognition of the vast damage they do is becoming general. One result of this is that entomology, as an applied science, has attained a status and importance that would not have been thought possible a generation ago

The almost world-wide attention that has been directed of recent years to problems of insect pests has naturally led to the investigation of new methods of controlling them Though considerable strides on the chemical and physical side have been made in advancing our knowledge of insecticides and of apparatus for using them (even aeroplanes having been adapted for this purpose), it is now fairly widely recognised that such methods are seldom more than palliatives and necessarily involve an annually recurrent expenditure Indeed, it is not too much to say that the damage done by insects, when the cost of keeping down their numbers is added to it, materially increases the cost to the consumer of nearly everything he eats and much of vegetable and animal origin that he wears or uses in other ways. Artificial control measures have the further disadvantage that most of them are unsuitable for use by the uneducated native populations, who are yearly producing more and more of the crops of cotton and other tropical products that are exported to other countries

One of the primary causes of an insect becoming sufficiently numerous to reach the status of a pest is the action of man himself, who, in the processes of agriculture, destroys the equilibrium that exists under natural conditions between insects and their various enemies A pest with a somewhat different origin, and one often most difficult to deal with, is an insect that has been accidentally or thoughtlessly introduced into a new country where the climatic conditions may be specially favourable to it and the natural enemies that kept down its numbers in its native country do not exist. That this should have already occurred in the temperate regions of the New World and of the southern hemisphere is not surprising, and some of the worst pests in Canada, South Africa, Australia, and New Zealand are in fact of European origin and not indigenous in those countries Many examples of this might be cited, but one with which most people are probably familiar is that of the This insect, Codling Moth, which infests apples though not of any great importance in England, and seldom found in numbers except in neglected orchards, is a major pest in all the more temperate parts of the British Empire. Elaborate spraying operations have to be carried out against it, and these materially enhance the cost of imported

apples, while the fact that the best insecticide used for it contains arsenic has caused much loss and confusion to the trade in imported apples owing to the risk of arsenical residues being found on them.

Though every country now has a more or less elaborate code of quarantime laws directed to keeping out insect pests, they can never be an absolute safeguard, and it is too much to expect that what has happened in temperate climates will not repeat itself in tropical ones with the ever-increasing exchange of tropical products that is now going on Indeed, the history of recent years shows that this is already happening, as can be seen by the spread, within the last ten years, of the dreaded Pink Bollworm of cotton into the New World

Realisation of all this has led the modern entomologist to try to take a leaf out of the book of Nature, and to see whether what may be called artificial methods of insect control cannot at least be supplemented, and perhaps in some cases superseded, by utilising parasitic insects or other enemies to reduce the numbers of a given pest. Though this method obviously has great limitations and must be applied with great circumspection, it has the outstanding advantage that, if successful, its results are permanent, and that the expense it involves is limited to the original cost of the preliminary investigation and of the breeding, exportation, and establishment in its new home of the parasite concerned. It is not, however, suggested that this method can be expected to eliminate altogether the necessity for artificial control measures except in rare cases, since a parasite in the nature of things does not normally exterminate its host (a procedure that would involve its own extinction), but merely reduces its numbers to such an extent that a major pest may become one of mmor importance.

It is obvious that great care must be exercised in the carrying out of such a scheme, and certain cardinal principles are involved. Perhaps the chief of these is that in the majority of cases the parasite selected for introduction must be a highly specialised one that is unlikely to affect the balance of Nature in its new home by attacking anything but its intended host or a species nearly allied to it. It is also important to discover the most effective parasite of the many that commonly attack a given Harm may be done by the importation of several parasites, all of which compete for existence in the same host. Though there is some doubt on the point, it has been stated that in Hawan, where some of the pioneer work of this character has been carried on, when several parasites of the Mediterranean fruit-fly were simultaneously introduced into those islands, they ultimately proved less effective owing to the numbers of the most efficient species being reduced by competition with the others. Similarly, the utmost care has to be taken to eliminate all hyper-parasites, that is to say, parasites of the parasite itself, for these may practically cancel its effect on the host, and it must be borne in mind that once such minute insects are established in a new country their eradication is impossible. Moreover, a parasite that is only moderately effective in its native country may become vastly more so in a new one if its hyper-parasites are absent. It will therefore be obvious that the successful accomplishment of a scheme of this character involves much careful and often lengthy investigations sometimes extending over several years, and that satisfactory results cannot be guaranteed in advance

The Government of the United States has devoted large sums in recent years to establishing laboratories where work of this kind may be carried out, and early in the present year it passed an Act that appropriated no less than 10,000,000 dollars for work on the European Corn-borer, an

introduced moth that is doing a vast amount of damage to maize, and the parasites of which are being bred in France for export to North America.

In order that a start may be made on these lines in the British Empire, the Empire Marketing Board has recently provided the Imperial Bureau of Entomology with funds to maintain a laboratory at Farnham Royal Work has just begun there, but it is not to be expected that any important results can be attained before next year at the earliest, though it is probable that, as a small beginning, a Braconid parasite of the blow-flies that cause serious losses amongst sheep may be sent in the autumn to Australia, New Zealand, and the Falkland Islands. Several investigations have, however, been begun or are being planned, which, it is hoped, will benefit many other parts of the Empire, including Canada, Australia, New Zealand, South Africa, and Kenya Colony.

## News and Views.

An agreement between the I.G Farbenindustrie (the German Dye Trust) and the Standard Oil Company of New Jersey for the exploitation of a new process for the production of synthetic petrol which the I.G. has evolved, was reported in the Times of Aug. 11. This agreement relates solely to the American markets, and further negotiations, it was stated, may be expected with European countries in respect of the realisation of the patent rights concerned. Much speculation appears to have arisen as to the precise nature of the process in question, as only the most meagre information has been officially forthcoming. But the few details provided in the Times report are sufficient to identify it with reasonable certainty as that which forms the basis of a group of very recent patent applications emanating from the I.G. This new process, described as the destructive hydrogenation of carbonaceous materials, appears to comprise nothing more than a development of the well-known Bergius method, according to which coal or similar material is subjected to thermal decomposition in the presence of hydrogen under pressure to produce hydrocarbon mixtures of the nature of petroleum. But whereas berginisation is essentially non-catalytic, the new process is based upon the discovery that the introduction of certain catalysts leads to the formation of more valuable hydrocarbons, with increased yields and at an enhanced rate.

The first of these catalysts to be protected by the I.G. were compounds of nitrogen, whether added as such or formed in situ from added nitrogen; then followed molybdenum and its compounds, then chemically combined sulphur, then tungsten and chromium, until now a whole host of such substances have been described. Furthermore, the hydrogen need not be so highly concentrated as in the bergmisation method; it may even be present as combined hydrogen, e.g. as hydrogen sulphide or methane, or it may be produced by the introduction

of steam which reacts with the carbonaceous material. Otherwise, the reaction conditions appear to be very similar to those obtaining in the berginisation method. Like the latter, it is applicable not only to coal and other solid materials, but also to the treatment of tars, mineral oils, or their distillates, and even to such bodies as asphalts and resms. Presumably it is in the treatment of heavy oil distillates and residues that the Standard Oil Company is interested, for any process using coal as starting material could scarcely be an economic proposition for some years to come in the United States, considering its natural oil resources. It may be remarked that the engineering difficulties associated with the treatment of large quantities of materials under the high temperatures and pressures proposed (of the order of 500° C. and 200 atmospheres) are very considerable, even to an organisation like the IG., which has unparalleled experience of the technique of high-pressure working. Any estimation of the commercial importance of the process must therefore be reserved until it has definitely emerged from the experimental stage and more detailed information is available concerning it

It is now twenty-one years ago since the Victoria Falls and Transvaal Power Company was granted rights to utilise the Falls for the generation of electric power. Hitherto the Company has only used steam plant to produce power, and recently it has received a communication from the Northern Rhodesia Government in which stress is laid on the principle that it is not in the public interest that this source of power should remain indefinitely unused. The Company has replied that it has always been anxious to utilise the power of the Falls commercially as soon as possible. It is quite willing that the rights and conditions granted twenty-one years ago should be suitably modified or expanded, in a similar way to that adopted in other countries for the control of power undertakings. The Company was founded with the object of supplying the Transvaal gold

mines with power from the Falls. It was soon found out that owing to the heavy costs of transmission the scheme was then commercially impracticable. The company has endeavoured to find an outlet for power in Rhodesia. The vast size of the country, however, the widely scattered white population, and the fact that the Falls are situated at such a great distance from centres where there might be possibilities of export trade, present serious difficulties in the way of development. It is doubtless these difficulties that have prevented industries requiring large amounts of cheap electrical power from being attracted to the country.

In an interesting paper to the Wireless World of July 13, Captain Eckersley, the engineer to the British Broadcasting Corporation, discusses the considerations which led to the proposal to establish a new distribution of broadcasting stations in Great Britain so as to enable listeners to have the choice of alternative programmes The problem is a difficult one owing to the variations in the reception depending on the distance from the broadcasting station. If an alternative programme is provided, it must be possible for any one to switch from one to the other with great ease. It is useless to give as an alternative a programme the reception of which is distinctly inferior. The author divides the service areas round a broadcasting station into zones, which he calls the 'wipeout 'area, the A, the B, and the C service areas. The wipe-out area is bounded by the field strength contour of about 30 millivolts per metre. In this area, cutting out the local station is difficult unless very special apparatus is used. In the A area the field strength lies between 30 millivolts and 10 millivolts per metre, in the B area between 10 millivolts and 5 millivolts per metre, and in the C area between 5 millivolts and 2 5 millivolts per metre.

In an A service area defined as explained above the listener is practically certain of an uninterrupted service, and electric trains or trams or X-ray apparatus will rarely affect him. In a B service area there is good crystal reception, but in a C service area the listener is often at the mercy of outside interference. In London the 'wipe-out' area is roughly a circle of six miles radius, with its centre at the broadcasting station. The space between this and a concentric circle of about 12 miles radius is the A service area. A circle of 18 miles radius includes the B service area. and the C service area is included within a radius of 30 miles Daventry having a long wave-length attenuates much less rapidly than London. In the future, much higher aerials must be used so as to improve the efficiency of the radiation. To get an even distribution this efficiency must be improved to the utmost. By international agreement Britain has been allotted ten wave-lengths. The author considers that the best way to reframe distribution is to use for the main service fewer transmitters. He thinks that five centres of distribution, each using two wave-lengths, would be the best.

SIXTY per cent. of the total cost of farm produce is chargeable to power and labour; farmers cannot,

therefore, afford to neglect any possible means of reducing such costs. Mr. R. Borlase Matthews, in the Scottish Journal of Agriculture, vol. 10, p. 271, discusses electricity in farming and gives several striking examples of economy that can be effected by its use. He considers electricity profitable at 8d. a unit for light and 4d. for power, though in many cases, especially where manual labour is at present employed, a considerably higher rate would be found economic. Electric lighting has proved very successful in poultry houses during the winter months, 15-35 per cent. more eggs being obtained at a time when prices are highest, owing to the increased hours of feeding and exercise, bees also have been found to produce 17 lb. more honey per hive per annum when electrically lighted and heated. Electric power is particularly suited to dairy work owing to the special need for cleanliness, and when used for cream separating or other daily operations where manual labour is at present employed, the cost of installation may be recovered in twelve months. Great saving is also obtained by the use of electric milking machines.

Mr. Matthews states that hay can be artificially cured by electric power, and has a better aroma and greater nutritive value than the naturally cured pro-The hav is cut green or even wet and stacked immediately; air is then driven in through wooden ducts, the moisture and heat evolved being thereby dissipated. The curing depends on temperature control and the arresting of the process at the correct point. Electric ploughing is not yet used as much in Great Britain as on the Continent, but even at its present stage it compares favourably with all other methods of ploughing. Special types of farm buildings are not necessary before electrically operated machinery is installed; in fact electric power is being successfully used in many low buildings in Scotland. Besides the enormous commercial value of the development of electric power in farming, there would result a social service of the first importance, namely, the raising of the standard of life in rural areas

Adjoining the Brent Valley Golf Links in the Borough of Ealing is an estate of seven acres, the greater part of the grounds of which have, from being left almost entirely untouched for fifteen years or more, become a recognised haunt of birds, and many species are known to have nested there. The Selborne Society has long wished to protect the ground in question, and at last there is an opportunity of acquiring it It has been suggested that it would make a fitting memorial to the late W. H. Hudson, who helped the Selborne Society to establish the Brent Bird Sanctuary at Perivale higher up the river. Lord Montagu of Beaulieu, Lord Avebury, and Sir John Otter are making an appeal for funds to form the new bird sanctuary. Donations towards the purchase and maintenance of the property should be sent to the treasurer of the Selborne Society, Sir John Otter, at the Hermitage, Hanwell, W.7.

An esteemed contemporary, Chemistry and Industry, with enviable bonhomie, frequently looks out upon the world with a twinkle in its eye—occasionally

with juxtaposition of tongue and cheek-and sees all kinds of delightful things beyond the strict range of its title. Thirty of these glimpses (Dr. Stephen Miall calls them "Chemical Reflections") have been collected and republished by Messrs. Ernest Benn, Ltd., for the entertainment and (or) instruction of a wider circle. The author, although he denies being either a chemist or a writer, has indeed a pretty wit and a sturdy commonsense which give point to his remark (page 21) that "it costs less to read Chemistry and Industry than to take stalls to see 'No, No, Nanette.'" Thoughts on an oyster jostle with the coking of coal; holidays (two of them), science and religion in the United States, bad trade, the scope of organic chemistry, the late Labour Government, and one or two outstanding personalities are all 'reflected' as in a mirror, which, to be candid, has not always a plane surface. That, however, naturally makes the reflections all the more amusing.

Mr. H. Barkley, of the Commonwealth Weather Bureau, read a paper on "Some Correlations between Ramfall and Production in Australia," to the University of Melbourne Agricultural Society, on June 10. Mr. Barkley began with a consideration of area rainfall in Australia; he showed from observations made over a period of years the possibility of ascertaining the frequency distribution of rainfall in any district He pointed out that a calculation of the probability of rainfall in excess of a certain minimum in one year followed logically from such data; the use of such calculations made the risks of the pastoral industry ascertainable. Turning to the wheat crop, Mr. Barkley showed that in the curve of annual yields there is a steady rise, due presumably to the introduction of superior methods of cultivation, and that the mean curve can be calculated, from this curve there is an 80 per cent. correlation between August-September precipitation and final yield. Crop estimates based on this method have the great ment of being early. In the season 1926-27 they were within 10 per cent. of the yield finally reported. Rains in October and November have some influence on the yield, but chiefly in increasing grain size and water content. Dealing with the pastoral industry, Mr. Barkley showed that grazing capacity per acre is in the western half of the State correlated with rainfall, and that average fleece weight varies in conjunction with that of January and February. In the eastern half of the State, where the ramfall is considerably higher, and in the central district, where hand feeding is frequent, the results are divergent. As regards lambing, observations on certain large estates show the existence of a close correlation between the combined precipitation of January and April and lamb-production.

The full programme has now been issued of the meeting on Sept. 1-4, at Basel, of the Swiss Society of Natural Sciences. Dr. Fritz Sarasin will deliver his presidential address on Sept. 1, and special lectures will be given by Profs. A. Brachet, L. Courvoisier, L. Duparc, and H. E. Sigerist, as was announced in

our issue of June 11, p 866 The fourteen sections into which the scientific work of the meeting will be divided, together with the names of the sectional presidents, are as follows Medical biology (Prof. R Stachelin, of Basel), chemistry (Prof. H Rivier, of Neuchâtel); physics (Prof. P. Debye, of Zunch); geophysics, meteorology, and astronomy (Prof. S. Mauderli, of Bern), mathematics (Prof F. Gonseth, of Bern); pharmacy (J. Lang, of Davos); geology (Prof A. Jeannet, of Neuchâtel); mineralogy and petrography (Prof M Rheinhard, of Basel), palæontology (Dr A. Tobler, of Basel), zoology and entomology (Prof A Reichensperger, of Freiburg), general botany (Prof E Wilczek, of Lausanne); systematic botany and plant geography; anthropology and ethnology (Prof R. Zeller, of Bern), history of science and medicine (Prof G. Senn, of Basel). Excursions of special interest to geologists, petrographers, and botanists respectively have been arranged as well as numerous social functions. The chairman of the reception committee is Dr. J. Roux, Naturhistorisches Museum, Augustinergasse 2, Basel

THE third meeting, since the War, of the International Commission for the Exploration of the Upper Air is to be held at Leipzig on Aug 29-Sept. 3. The previous meetings were at Beigen in 1921 and in London in 1925. Sir Napier Shaw is president of the Commission, in succession to Prof. V. Bjerknes; the secretaries are Dr Th. Hesselbeig, director of the Meteorological Institute of Oslo, and Mr R. C K. Lempfert, assistant director of the Meteorological Office, London. The local arrangements are in the hands of Prof. Dr Weickmann of the Geophysical Institute of the University of Leipzig. The principal business of the meeting is to consider ways and means for the re-establishment of the publication of the results of the international cooperation in aerology in continuation of the agreement arrived at in St. Petersburg in 1904 which was interrupted by the War. In accordance with instructions of the Commission, a specimen volume of "Comptes rendus des jours internationaux, 1923," has been prepared, and with the aid of contributions from the Meteorological Section of the International Union of Geodesy and Geophysics, and from other sources, has been printed for circulation main features, the volume follows the precedent of the "Réseau Mondial," an annual volume of observations of pressure, temperature, and rainfall for the globe, which is published by the Meteorological Office, Air Ministry, and dates back to 1910; but the specimen volume contains two new features: first, a folio of maps of the distribution of pressure over each hemisphere on the thirty-six "international days" of 1923; and secondly, a folio of "tephigrams" or representations of the results of observations of registering balloons on the international days expressed as curves referred to absolute temperature and entropy as co-ordinates, and therefore specially expressive of the energy of dry or saturated air in the atmosphere on those days.

The Chemiker-Zeitung of June 22 contains a special supplement dealing with the progress of industrial morganic chemistry in the years 1924–1926. The review is by no means confined to progress in Germany but extends to other countries. The nitrogen problems are dealt with in very considerable detail. Then follow a lengthy account of progress in the manufacture of dyestuffs during 1926 and a report on synthetic sweetening substances during 1925–1926. The value of these reports is greatly increased by the numerous references to patent literature and to other journals.

The Report of the National Research Council of the United States for the year ending June 30, 1926, shows that the expenditure of the Council for the year was approximately a million dollars, about a third of which was disbursed for Research Fellowships. These are awarded to candidates who have gained the Ph D. degree or its equivalent and have shown marked ability in research. For the year 1925–26 the number of fellowships awarded was: in physics 26, chemistry 26, mathematics 11, medical sciences 36, anthropology 4, botany 11, zoology 11, psychology 7, seed germination 1. Others are appointed in co-operation with organisations affiliated with the Council, for research in agricultural and industrial problems. In agriculture 7 fellowships were awarded.

VOLUME 18 of Contributions from the Jefferson Physical Laboratory of Harvard University contains reprints of forty-three papers by the staff and students published during the year 1925. Seven of these relate to the effects of high pressure on viscosity, compressibility, or magnetic susceptibility, three to band spectra, ten to X-ray phenomena, three to the Hall and related effects, four are on photo-chemical problems, and several deal with the atom and its structure. About a third of these papers are due to the work of the four National Research Fellows at the Laboratory. Prof. Bridgman's paper on the effect of pressures up to 12,000 atmospheres on the viscosities of forty-three pure liquids is one of the longer papers and forms a valuable addition to the information which is being got together by the Research Committee on Lubrication of the American Society of Mechanical Engineers. A short paper describes the equipment of the Cruft High Tension Laboratory for precision X-ray research, and the volume includes obituary notices of Profs. Sabine and Trowbridge by Profs. Hall and Lyman respectively. No one with this volume before them can doubt the value of the Jefferson Laboratory as a centre for research.

Under the will of the late Thomas L. Gray, the Royal Society of Arts is residuary legatee of his estate for the purpose of founding a memorial to his father, the late Thomas Gray, who was for many years Assistant Secretary to the Board of Trade (Marine Department). The objects of the trust are "The advancement of the Science of Navigation and the scientific and educational interests of the British Mercantile Marine." The Council now offers a prize

of £100 for a valuable improvement in the science or practice of navigation proposed or invented in the years 1927 and 1928, and a prize of £50 for an essay on "The Practice of Navigation in the Mercantile Marine" The essay must be based on the actual methods used by the writer during his career, with special reference to the instruments used as aids to navigation, and the effect of stowage of cargo on the steering, speed, and safety of the vessel. Essays must be typed or clearly written and must be sent in under a motto, accompanied by a sealed envelope enclosing the author's name. Competitors must send in their essays not later than Dec. 31, 1928, addressed to the secretary of the Royal Society of Arts.

WE have received from Messrs. Brown and Son, of Alembic Works, Holloway, London, N, the fourteenth edition of their catalogue of laboratory apparatus and equipment. The greater part of the volume is devoted to apparatus suitable for industrial research laboratories and the larger technical institutes Illustrations are given of benches and other fittings supplied to the laboratories of H M. Government, the Imperial College of Science, the University of Liverpool, etc Considerable space is devoted to ovens and stills, combined or separate, suitable for large or small laboratories Electrically heated ovens, vacuum ovens, and high-pressure steam ovens, incubators heated by gas or electricity, centrifuges, explosion cupboards with sliding steel doors, electrical tube and muffle furnaces, mixing machines for stiff pastes, end-runner mills, tilting boiling-pans and cold storage chests will be found in the list. Special features are patent self-sealing autoclaves, designed to withstand pressures up to a thousand atmospheres. rectifying stills for alcohol and other liquids, with capacity ranging from five to fifty gallons, and electrically heated Soxhlet extractors for ordinary laboratory use or for quantities up to twenty gallons of solvent.

Readers interested in early maps and geographical books should see the latest catalogue (No. 498) of Mr. F. Edwards, 83A High Street, Marylebone, W 1. which gives particulars of upwards of 1200 items, some of great rarity. Reproductions of the most interesting maps are given. The catalogue will be sent free upon application

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:-Inspectors of stores for the Indian Stores Department-The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.I (Aug. 22). A junior technical officer at the Royal Aircraft Establishment to assist in the experimental development of electrical equipment for use in aircraft—The Chief Superintendent, R.A.E., South Farnborough, Hants (Aug. 27, quoting A.199) An advisory agricultural economist in the University of Reading-The Registrar, The University, Reading (Aug. 27). An assistant inspector of weights and measures in the Weights and Measures Department of the City of Nottingham—The Town Clerk, The Guildhall, Nottingham (Aug. 29). A lecturer in radiology, a lecturer in anæsthetics, a demonstrator for the prosthesis room, and a demonstrator for the conservation room of the Cairo Dental School—The Director, Dental School, Ministry of Education, Cairo (Sept. 1). An assistant lecturer in mechanical engineering at the Bradford Technical College—The Principal. Technical College, Bradford (Sept. 5). An adviser in agricultural zoology and a research assistant for soil survey work in the department of agriculture of the University College of North Wales—The Secretary and Registrar, University College (Department of Agriculture), Memorial Buildings, Bangor (Sept. 10). A professor of dentistry

m the University of Otago, New Zealand—The High Commissioner for New Zealand, 415 Strand, W C 2 (Sept 15) An assistant lecturer in physics in the University of Manchester—The Registrar, The University, Manchester (Sept 20) An assistant lecturer in economics at Auckland University College, New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2. A junior assistant physicist, under the directorate of radiological research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18.

## Our Astronomical Column.

Conjunction of Jupiter and Uranus—These two planets reach opposition next month, and are now observable well before nudnight. They have been in south declination for many years (six and forty-two respectively) and have now returned to the equator On Aug. 19 Uranus is 49' due north of Jupiter, so it is an easy opportunity to identify the former planet It is visible to the naked eye in a clear sky with acute sight, if one knows exactly where to look.

MAXIMUM OF MIRA.—This remarkable variable star is due to attain its maximum at the end of September, as it will then be nearly opposite to the sun, the conditions for observation will be very favourable. It is already visible to the naked eye, but it is not high enough for convenient observation until after midnight. It will be interesting to compare Mira with neighbouring stars during the next few weeks, and to note its gradual increase in light. The star attains the second magnitude at some maxima, the third at others

SKY ILLUMINATION DURING THE TOTAL SOLAR ECLIPSE OF JUNE 29.—It has been observed in several eclipses that the recovery of light at the end of totality appears to be far more rapid than its decline at the beginning of it. Miss Catherine O. Stevens. writing from 3 Heron Court. Richmond, Surrey. refers to the total solar eclipse of June 29 in particular, and ascribes the effect to the fact that the shadow cone pierced the atmosphere at an angle so acute that it reached the atmosphere vertically above any locality in advance of its arrival at the place itself, and so caused a good deal of gloom before totality. Allusion has already been made to this effect in NATURE of July 9 in explanation of the fact that the descent of darkness and return of light at Colwyn Bay happened some seconds before the actual beginning and end of totality. It may also have had an effect in causing the return of light to be more rapid than its withdrawal, but in this case the effect ought to be reversed at an evening eclipse, the with-drawal being more rapid than the return. Such an effect is seldom if ever noted. It was certainly not the case at the afternoon eclipse at Algiers in 1900, but in that case the air was so transparent that atmospheric effects would be much less conspicuous.

COMETS.—No further news of Gale's comet has come to hand, and it is to be feared that the object has been lost. It is, however, possible that unreported observations have been made in the southern hemisphere.

Senhor Mello e Simas has published some researches on the conjectured identity of Comet Comas Sola with 1890 VII (Spitaler). He has carried the position of the former back to 1912, when it made a near approach to Jupiter, and finds that it was about four astronomical units from the position of the latter, brought

up from 1890, with perturbations by Jupiter up to 1901. He concludes that the two comets are not identical, but this cannot yet be considered as definite; Spitaler's comet was a difficult object in 1890, and the observations were neither numerous nor very exact. It is, therefore, quite possible that its accepted period is sufficiently in error to permit of the two comets being identical. The orbit of comet Comas Sola is much better known, since this has been well observed under favourable conditions for more than half a year; it would seem, therefore, to be the safer course to start from this end, and work back with different assumed periods, to see whether any of them would fit with Spitaler.

L'Astronomie for August contains an article by Mme. Flammarion on comet Pons-Winnecke, with reproductions of two photographs taken by M. F. Quenisset on June 23. The comet appears as a large nebulosity, some 25' in diameter, slightly extended to the north, that is, towards the sun The nucleus was of mag. 9. On June 26-27 a tail 1° long — was photographed, in P.A. 230°. The comet was easily visible to the naked eye as a small white transparent cloud, not unlike the Andromeda nebula.

Dr. G. Merton has obtained the following photographic observation of comet Grigg-Skjellerup

July 5 96768 U.T., R A. (1927 0) 17<sup>h</sup> 19<sup>m</sup> 38 76<sup>s</sup>, N. Decl. 39° 36′ 27·5″.

He gives the following continuation of the ephemeris  $(0^{\text{h}})$ :

		KA.			IN.	Dect.	$\log r$	tog //
Aug.	20.	$18^{\rm h}$	$31^{\mathrm{m}}$	85	120	22 7'		9.9290
_	24.	18	36	12	10	49.7	0.2261	9.9563
	28.	18	41	19	9	$23\ 2$		9.9830
Sept.	1.	18	46	29	8	$3 \cdot 1$	0.2454	0.0090

Search ephemeris for Schaumasse's Comet (from B.A.A. Jour., March 1927, p. 240):

	Perihei	ion, Sept. :	27 0.	
Oh U.T.	R.A.	N. Decl.	$\log r$ .	log ∧.
Aug. 22.	$8^{\rm h}~18~9^{\rm m}$	21° 25′	0.1022	0 3206
30.	8 51.6	20 31	0.0898	0.3121
Sept. 7.	9 24.7	19 13	0.0798	0.3055
15.	9 57 7	17 33	0.0728	0.3007
23.	10 30 5	$15 \ 34$	0.0693	0.2982
	PERIHE	LION, OCT.	5.0.	
Aug. 22.	8h 0.5m	21° 21 <b>°</b>	0.1165	0 3174
30.	$8 \ \ 32.7$	$20 \ 41$	$0\ 1022$	0.3071
Sept. 7.	9 $5.6$	$19 \ 39$	0.0898	0.2978
15.	$9 \ 38.7$	18 14	0.0798	0.2911
23.	10 11 7	16 29	0.0728	0.2863
mi-	11 1 1			. 7 0

The comet will be low in the north-east just before dawn. It is very desirable to find the comet this year, as the circumstances will be more unfavourable for observation at the next return in 1935.

Later Transaction

### Research Items.

EARLY MAN IN AMERICA —In the Scientific American for August, Mr. Harold J. Cook returns once more to the question of the antiquity of man in America. He recapitulates the circumstances of the discovery of the Nebraska tooth in the tertiary deposits of the divide between the North Platte and Niobrara Rivers near the Agate Spring Fossil Quarries These deposits were discovered by the writer and Dr. W. D. Matthew in 1908 and have proved rich in mammalian remains of tertiary age, some showing distinct relationship with Asiatic forms Fresh discoveries were made year by year until the owner of the land ordered the work to stop. Work by Mr. Albert Thompson, of the American Museum of Natural History, on an adjacent ranch produced from among the remains of a characteristic phocene fauna evidences of human culture in the form of artefacts of green bone of contemporary animals implements some are drilled, many shaped or shaipened in various forms, while others have been used for pounding. Such is the result of a preliminary critical study by Prof. Fairfield Osborn and Mr Thompson. The resemblance of these implements to those of modern Indian workmanship has already been pointed out. In January last investigations were begun on a site farther south at Frederick, Oklahoma, on a ridge of sand and gravels lying on the eroded surface of Permian Period Red Beds. The geological evidence shows that the top of the highest hill in this area was once the bed of a river. It is now one hundred feet above valley level and two hundred and eighty feet above the present Red River. Three periods of deposition on the old Red Bed floor are shown. In Bed A, associated with typical pleistocene animal remains were stone implements made by man, showing a degree of culture comparable with that of the modern Indian nomads of the plains. This evidence would, therefore, support the view that the Indian has changed little over a very long period of time, and meet the arguments of those who refuse a high antiquity to the Indian on account of the modern character of the remains, skeletal or other. discovery is dated tentatively at a period of 365,000 years ago and affords the most conclusive evidence of Glacial Age man yet found in America.

CANCER AND ITS TREATMENT.—The Irish Radium Committee has issued its Report, compiled by Dr. Walter Stevenson and Mr. Maurice Hayes, on the treatment of cases of cancer by means of radium and radium emanation during the year 1926. A large proportion of the cases was unfortunately at an advanced stage and a palliative effect only could be hoped for: in this respect the treatment is attended with considerable success In a small number of cases, with or without operation, the treatment has apparently effected a cure. Rodent ulcer is particularly amenable, and certain non-cancerous conditions, such as ulcers, local sepsis, sciatica and others, were much benefited (Sc Proc. Roy. Dublin Soc.. vol. 18, No. 39, 1927, p. 443). The Ministry of Health has issued a Report by Dr. Janet Lane-Claypon on a statistical inquiry into the results of treatment of cancer of the uterus (Reports on Pub. Health and Med. Subjects, No. 40). The Report is based on the examination of data published prior to March 1926, contained in 848 articles derived from sixteen different countries and dealing with some 80,000 cases of the disease. The principal findings are (1) that patients do not seek advice until an average period of 6-9 months has elapsed after the first occurrence of symptoms, (2) that rather less than half the patients who then apply for treatment are at a stage at which effective operation is practicable, (3) that the results of operation at an early stage of the disease are roughly twice as good as those in patients whose disease is still practicable for operation but who apply late, and (4) that cancer of the cervix is not more serious in younger than in older women.

MINERS' AND QUARRYMEN'S PHTHISIS.—Inhalation of dust containing sharp particles of silica or quartz induces in those subjected to it either a condition of fibrosis of the lungs or the same condition complicated with tuberculous infection—the true miners' phthisis. The last-named variety in the Rand mines has been the subject of a study by Mr. Mayrogordato Down to 1905 the dust particles in the air of the mines averaged 150 mgm. per cubic metre of air, with a phthisis incidence of 30 per cent. Since then, by the compulsory use of certain measures, the dust particles were reduced to 20 mgm. in 1911, to 5 mgm. in 1913, and to 2 mgm. in 1921, with a fall in the phthisis incidence to 14 per cent. in 1915, 10 per cent. in 1916, and 3 per cent. since 1921 (Publications of the S. African Institute for Med Research, No. 19, 1926). A similar effect from the inhalation of quartz particles derived from slate dust is apparently seen in the high incidence of phthisis among the slate workers in the Gwyrfai of phthisis among the state workers in the Computation of a Report by Dr. T. W. Wade to the Ministry of Health (Reports on Pub. Health and Med. Subjects, No. 38, 1927). The phthisis death-rate among the slate quarrymen and workers of Gwyrfai reaches a maximum at about sixty years of age, being then about \$2 per 1000 whereas the general death-rate for males. 8 per 1000, whereas the general death-rate for males from phthisss in England and Wales at that age is only about 1.25 per 1000. Males other than slate workers of Gwyrfai of the same age have a phthisis death-rate only a trifle more than that for England and Wales.

MIGRATION IN APHIDES.—In Science Progress for April and July, Dr. J. Davidson, of the Rothamsted Experimental Station, discusses the biological and ecological aspects of migration in aphides. True aphides of the family Aphididæ (as distinct from the Phylloxeridæ) may be separated into non-migrating species, whose whole life-cycle is spent upon one type of plant, and migrating species. In the latter case one portion of the life-cycle occurs on one type of plant (primary host) on which the fertilised eggs are laid, while the remainder of the life-cycle consists only of parthenogenetic generations which occur in association with other types of plants (intermediate hosts). The primary hosts are trees or shrubs, while the intermediate hosts may be herbaceous plants or other trees and shrubs. The complete life-cycle is practically confined to species occurring in temperate climates. In warmer countries such as Formosa, Java, and the southern United States the sexual phase is frequently suppressed, and continuous parthenogenetic reproduction is the rule. The migrating habit seems to have developed in relation with changes in the world's flora. Those species which are primarily non-migrating, such as members of the tribes Lachnini and Callipterini, exhibit certain primitive characters. The migrating species, on the other hand, exhibit varying degrees of specialisation in habit and form correlated with the extent to which the migratory habit has developed. In general, those species associated with herbaceous plants represent the most recent development in aphid evolution.

THE CONTROL OF THE TSETSE-FLY -In the Bulletin of Entomological Research for June 1927, Drs. Ll. Lloyd, W. B. Johnson, and P. H. Rawson have an important paper dealing with experiments in the control of the Tsetse-fly in Northein Nigeria An interesting experiment was carried out in which wild game was excluded from a good secondary focus of Tsetse-fly by means of a strong fence. This set up a state of starvation in the case of the species moi sitans and to some extent in tachinoides There was marked reduction in abundance of both species of the Tsetse, especially of *morsitans*. It is considered that game destruction, if it could be effectually accomplished, would lead to the disappearance of the latter species, but not tachinoides. It is for this reason that a policy of game destruction is not recommended; it is suggested, on the other hand, that a policy of laissezfaire towards the game in Northern Nigeria so that the increase of wild Ungulata is checked, would tend to restrain the increase and spread of the Tsetse. A successful experiment in deferred grass burning is described. The late sweeping fire was found to result m a great mortality of the flies and their pupæ in both the species of Tsetse It scarcely affected the growth of established thicket, but probably checked the expansion of such and the formation of new thicket. It is considered that late grass burning, well organised, might have a good effect in Tsetse reduction in Northern Nigeria, but there are great difficulties involved.

Animal Life in Hot Springs —Prot. C. 7. Brues has summarised (Quart. Review of Biology, vol. 2, No. 2, 1927) the main facts relating to animal life in hot springs. Thermal waters contain only a small amount of dissolved oxygen and they are often impregnated with salts in solution, usually either calcium carbonate or silica. Compared with plants, animals have considerably less power of adjustment to high temperatures, and even the most resistant forms of animal life are unable to endure the degree of heat at which certain plants thrive Of the insects which occur in hot springs the author refers to beetles, some of which have been reported from water at 115° F., and to the larvæ of Chironomus, which he found abundant in the mud of a shallow thermal pool at a temperature of 120° F. in Yellowstone Park. A few Crustacea have adopted a thermal habitat, e.g. species of Gammarus and of Cyclops and an isopod (Exosphæroma). This last is especially interesting, because a closely related extinct genus is preserved in hot spring deposits of lower Oligocene age, indicating a long thermal ancestry. Molluscs such as Physa and Limnæa are also known to mhabit hot springs. Tadpoles of a frog were found in Yellowstone Park in water at a temperature of 104°-106° F., that is, several degrees above the temperature at which unacclimatised tadpoles of the frog and the toad die.

Plankton Production.—There is an obvious need for some quick method of estimating the production of plankton in the sea to supplant the present laborious process of counting the diatoms themselves. It seems possible that such a method may be found in a study of the oxygen content of sea-water and its relation to the photosynthesis of the diatoms present. To this end preliminary observations were carried out by T. Gaarder and H. H. Gran in an investigation of the production of plankton in the Oslo Fjord in 1916 and 1917 (Cons. Internat. Rap. et Proc. Verb., 42, 1927). Hydrographic and plankton observations were made, and at the same time, by suspending flasks of sea water with its contained plankton at different depths, artificial cultural experiments were set up. Results obtained in the open waters could not be regarded as

conclusive on account of the constant changing of the water masses in the fjord brought about by currents. In the flasks the greatest reproduction among the diatoms in March took place at 2 m. and 5 m., and there was still sufficient increase at 10 m for the oxygen output to balance the uptake through respiration. In March the necessary nutritive substances occurred in the sea water in sufficient quantities in proportion to the consumption by the diatoms, but in September they were insufficient to produce a profuse development of diatoms. Addition of phosphates and nutrates to the water in the flasks in September caused a rapid production of 100,000 cells per litre in 3 days.

Plant Chimæras. — Numerous chimæras have been produced by Messrs Jorgensen and Crane (Jour. Genetics, vol. 18, No 2) in Solanum, using the well-known methods of Winkler. The species grafted together were S. lycopersicum, S sisymbrifolium, S. luteum, S. nigrum, and S. guineense species have different multiples of twelve chromosomes, as Winkler originally showed for some of them, so that the parental tissues can be identified in the chimera by means of the dividing cells. A new result is the discovery that in many forms, which were regarded as sectorial chimæras only, the superficial layers of a sector belonged to the other species. Such forms are really incomplete periclinals, and it is proposed to call them mericlinals. The morphology of the various chimæras is described, and it is shown that the periclinals generally show somatic instability, reverting to the pure form which forms the core. In one case, however, in S. lycopersicum-lutcum, in which there were probably three or four outer layers of luteum, reversion took place through transitional stages to the pure luteum.

CHROMOSOME ATTRACTIONS IN PLANTS.—The arrangements of the chromosomes at reduction have been studied by Dr. Belling (Jour. Genetics, vol. 18, No. 2) in Datura and other plants, especially in triploid, trisomic, and haploid plants. In haploid individuals the chromosomes show no mutual attractions. In diploids, corresponding ends of chromosomes attract each other, while the two ends of the same chromosome show different attractions. Long chromosomes may also show attractions at other points. From a study of triploids in which trivalent chromosomes are formed, the three members show the five expected arrangements. The fact that the triangle configuration does not normally occur indicates that the attractions of the two ends of a chromosome are different. On this hypothesis, eight configurations would be expected in totraploids and they have been found. The trisomic (2n+1) mutations of Datura give rise to certain secondary forms in which one of the chromosomes of the trivalent has the same attraction at both ends and consequently forms a small circlet. It is suggested that this has arisen through crossing-over in the middle between two homologous chromosomes lying parallel but with reversed orientation. There is also a suggestion of crossing-over between non-homologous chromosomes, producing an isomorphic strain which in crosses combines to form a ring of four chromosomes. These are further steps in showing that genetical variations have a cytological foundation.

TERTIARY CEPHALOPODA FROM JAPAN.—Cephalopod remains are rare in the Tertiary rocks of Japan, only three species having hitherto been described. Two new forms, Aturia aturi, var. tokunagar, and Nautilus (s s) japonicus, are now added to the list by S Shimizu, whilst a species hitherto identified with Aturia zigzag has been given separate rank as A. yokoyamar by

T Nagao (Science Repts., Tôhoku Imp. Univ., Sendai, Ser. 2, vol 9, No. 2). Excellent plates accompany both papers

INDIAN TERTIARY MOLLUSCA.-In 1909 the first part of Cossmann and Pissarro's work on the Mollusca of the Ranskot Series, comprising the Cephalopoda and Gastropoda, was published in the *Palæontologia Indica* (New Series, vol. 3, pt. 1). The second pointion on the Brachiopoda and Lamellibranchiata (with some species from the Cardita beaumonti beds) has now, after many vicissitudes, been issued (Pal Ind., New Ser. vol. 6, mem 2) A translation was made by the late Dr E Viedenburg from the original French and the two MSS sent to M Cossmann tor revision in 1915, but were lost without trace, probably sunk with other mails Fortunately a duplicate translation was found among Dr. Vredenburgs literary remains, and from that the present part has been prepared One brachiopod and twenty-five lamellibranchs, nine of which belong to the Cretaceous Cardita beaumonti beds, are described, including eighteen believed to be new species, and figured on four plates.

OIL IN AUSTRALIA —The vexed question of petroleum in Australia is once again mooted by the appearance of another report, this time dealing with portions of the Kimberley Division of West Australia, with special reference to the possible occurrence of mineral oil in the Fitzroy Basin, and written by Mr. T. Blatchford, Assistant State Mining Engineer. While we have nothing but praise for the painstaking efforts and perseverance of the many experts in their search for petroleum in this continent, the prospect of ultimate location of commercial oil-pools, especially in the West, seems mevitably slight, if on first principles alone, and a perusal of this report of another possible area does not incline one to a change of opinion. In the present instance the most likely beds would seem to be those of Cambrian age, with which some discovered bitumen outcrops are apparently connected, more particularly the Upper Cambrian beds overlying basalt flows. The author states that suitable structures exist in the area, and other conditions are tavourable, though proving the presence of oil will necessitate boring probably to 4000 or 5000 feet. Two trial borings through similar rocks in a contiguous district, at Mt. Wynne and the Ord River Basin, were unsuccessful, the Mt. Wynne boring being abandoned at 2400 feet without meeting oil-bearing beds, the Ord River bore being shut down in basalt.

PHOTOMETRIC MEASUREMENTS DURING THE TOTAL Solar Eclipse of June 29.—During the total solar echpse on June 29, Mr. J. S Dow made many photometric observations of the total illumination Although he was not quite in the centre of the belt of totality, he was favourably situated to observe the phenomena. He had previously made photometric observations of the partial eclipse of 1912 under excellent weather conditions and so knew exactly what to expect. He publishes his results in the Illuminating Engineer for August When he began his observations about 5 20 A.M. the sky was clearing of clouds. This led to an actual increase in illumination notwithstanding that the eclipse had begun At 6.10 the sun emerged from the cloud as a watery crescent, but it disappeared again just before totality and did not appear again until totality was over At totality the illumination fell with great rapidity for a few seconds and then rose with equal rapidity The lowest illumination recorded was about half a a foot candle. It then rapidly rose to more than 2000 foot candles, due partly to the passing of the eclipse

and the fact that the altitude of the sun was increasing. Owing to the clouds it was impossible to forecast accurately what the illumination would be, but the agreement between calculated and observed values in the 1912 echipse was excellent. Apparently values of the illumination so low as a fiftieth of a candle foot were obtained by an observer at Southport. It is practically impossible at present to predetermine the illumination resulting from a total echipse. It would be necessary to have accurate data of the candle power of the corona. Quite apart from the interference of clouds, the illumination probably varies with the width of the band of totality and the position of the observer on it.

A NEW SOURCE OF ARSENIC.—A paper has been published by R E Remington in the Journal of the American Chemical Society for June directing attention to a hitherto unsuspected source of aisenic in the human body. The author has examined a large number of brands of smoking and plug tobacco by means of the micro-Marsh method, and has found amounts varying from six to thirty parts per inillion These are many times in excess of the quantities permitted in foods. Nearly half of the arsenic in smoking tobacco is evolved in the smoke and about half of the arsenic in plug tobacco is soluble in water. The results show very clearly that a considerable part of the arsenic in tobacco may find its way into the body, and experiments are now being carried out to test this possibility conclusively.

THE PASSIVITY OF METALS —The unusual properties of iron and other metals which have been rendered passive by oxidising treatment have been attributed by many investigators to a protective film of oxide or other material. This explanation has been rejected by some chemists, since no film is usually visible, while iron which has been covered with a visible film by heating is often not passive. The presence of very thin films, too thin to give interference tints, has been proved by the work of U R. Evans, which has been published in the May issue of the Journal of the Chemical Society. He has found it possible to render these films visible by dissolving away the metal below them by anodic treatment or by means of iodine. The envelope of the iron electrode after anodic treatment consisted of two thin transparent parallel membranes of ferric oxide united at the two edges. There seems to be little doubt that this film is the cause of passivity; where the film is broken or contains cracks the metal is active.

Fog Production on the Neutralisation of HALOGEN HALIDES.—It has been noticed that when a current of air containing phosgene or phosphorus oxychloride is passed through charcoal and aqueous alcoholic potash, a fog develops in the vessel containing the alkali as soon as the charcoal is saturated. H. O. Askew has shown that both hydrochloric and hydrobromic acid vapours when passed into various alkaline solutions are capable of producing similar effects, more especially in the presence of colloids and dyes. A complete investigation of this subject is described in the *Journal of the Chemical Society* for May. It has been found that the relation between the amount of fog produced and the alkalı concentration, and also the amount of fog and the concentrations of the added active materials, are of the same form as the adsorption isotherm. The concentration of the acid in the fog particles and the water vapour pressure are constant and independent of the amount of fog formed, but the sizes of the particles decrease as the fogs become denser. The particles appear to have no electrical charges.

## The Leeds Meeting of the British Association.

PROGRAMMES OF SECTIONS.

THE arrangements for the ninety-seventh annual meeting of the British Association are now assuming final form, and the Local Committee at Leeds is confident that the meeting will be a success. Members are assured of a cordial welcome both from the City of Leeds and the University, and the programme of entertainments outside the Section rooms is an attractive one. The Lord Mayor and the University are giving receptions, garden parties are arranged; while for those who take more vigorous amusement a dance will be held On the evening of Sunday, Sept. 4, the Leeds Choral Union will give a concert in the Town Hall, to which all members are invited. The programme includes: Pianotorte Concerto (Grieg), "The Dream of Gerontius" (Elgar).

In the Crypt of the Town Hall there is to be an exhibition of scientific instruments and apparatus; while near the Reception Room the Meteorological Department of the Air Ministry will have an office for weather forecast work The B.B.C. is demonstrating the educational possibilities of wireless; and Mr. J. L. Baird, of the Baird Television Company, is undertaking to demonstrate television between London and Leeds during the latter part of the meeting, whilst during the first three days he will give demonstrations of nocto-vision and members will have the opportunity

of seeing a phonoscope.

Though a large industrial city with a 'smoke' problem, Leeds is a splendid centre for excursionists; and in order to meet their requirements the Local Excursions Committee has arranged a large number of attractive visits led by experts to the neighbouring country. The handbook of excursions, to be issued to each member, will be a book of permanent value to those who are interested in the district around Leeds. We have already mentioned that, thanks to the kindly offices of the Yorkshire Ramblers' Club, a number of members will be able to make the descent into Gaping Ghyll, and this will certainly be a very unusual excursion of any British Association meeting. Another excursion novelty is that to Doncaster to witness the 'St. Leger' as the guests of the Doncaster Corporation. York and Harrogate have also made preparation for the visit of a number of members; works and factories have extended invitations to members to make inspectional visits; and a number of descents into coal mines are planned. Those interested in art should not miss the opportunity of seeing the fine collection of Turners at Farnley Hall. A number of sectional excursions has also been arranged.

The list of foreign guests attending the Leeds meeting includes the following: in the department of the mathematical and physical sciences, Prof. Robert A. Millikan (Pasadena, California), Prof Peter Debye (Zurich), Dr. W. Kolhorster (Charlottenburg), Dr. W. Heisenberg (Copenhagen): in chemistry, Prof. Dr. H. Freundlich (Berlin); in zoology, Dr. S. Kopeé (Poland); in economics, Prof. J. Schumpeter (Bonn); in botany, Prof. Nils E. Svedelius (Upsala), Prof. Dr. E. von Brücke (Innsbruck), Dr. John P. Lotsy (Velp, Holland); geology, Prof. G. Delépine (Lılle), Prof. G. A. F. Molengraaf (Holland).

## SECTION A (MATHEMATICAL AND PHYSICAL SCIENCES).

UNDER the presidency of Prof. E. T. Whittaker, an exceptionally interesting programme has been arranged in Section A (Mathematical and Physical Sciences). Prof. Millikan is speaking on the spectra of the ele-

ments of the first row of the Periodic Table, and is also giving an evening lecture to the Association on cosmic rays Dr. Kolhorster will also speak on the latter subject in the sectional meeting A paper by Dr. Heisenberg on recent progress in quantum mechanics will be followed by a discussion in which Mr. R. H. Fowler and other English workers will take part. Members will also have the opportunity of hearing Prof Debye speak on the polar properties of molecules

Prof. Whiddington is to give an afternoon lecture on the luminous discharge in rare gases, which will include experiments illustrating his own researches, while the papers to be given by Dr. Aston and Prof.

Barkla are of special interest at the present time.

The joint discussion with Section B (Chemistry) on the structure and nature of colloidal particles will be o<sub>L</sub>ened by Sir William Bragg. There will also be several subsectional meetings. In mathematics a paper by Prof Turnbull on non-commutative algebra will serve as a useful introduction to the discussion on quantum mechanics, and, in addition to papers by Profs. Milne and Brodetsky, a morning will be devoted to contributions on the theory of numbers.

## SECTION B (CHEMISTRY).

THE main activities of Section B (Chemistry) will be devoted to three discussions On Thursday, Sept. 1, the president, Dr. N. V. Sidgwick, instead of On Thursday, Sept. formally reading his address, will open a discussion on "Co-ordination Compounds" Dr. Sidgwick is a recognised authority on this subject, which now occupies an important place in our knowledge of theconstitution of chemical compounds. Prof. G. T. Morgan and Dr. S. Sugden, who have made important contributions to the subject, will be amongst those taking part. The joint discussion with Section A on "The Structure and Formation of Colloidal Particles" on the following day should prove particularly interesting. Sir William Bragg, Prof. H. Freundlich of the Kaiser-Wilhelm Institut, and Prof. R W. Whytlaw-Gray are taking part. Prof. G. Barger will open the discussion on Sept. 5 on "The Chemistry of the Hormones." Profs. H. S. Raper, J. Mellanby, J. C. Drummond, and E. C. Dodds will also discuss these substances, the knowledge of which has recently been greatly extended by the elucidation of the chemical constitution of thyroxin and recent extensive researches in physiology and biochemistry. The morning of Sept. 6 will be devoted to the reading of miscellaneous papers, when Profs. H M. Dawson, John Read, and others will describe progress made in recent investigations. Throughout the meeting, excursions of special chemical interest have been arranged through the kind co-operation of a number of chemical manufacturers and research associations m and near Leeds.

## SECTION C (GEOLOGY).

THE country round Leeds is of special interest at the moment to the geologist conversant with rocks of Carboniferous age, but these rocks and the problems associated with them do not absorb all the attention of Section C. The programme of the Section is a full one; full not only of topics for discussion in the meeting room, but also of visits to places of interest in the neighbourhood where certain of these topics may be further considered in the field. Every branch of the subject is represented in the programme—physical and stratigraphical geology, palæontology, and petrology—while within the purview of each there are papers of interest to the general reader and others which will be of greater moment to the specialist. Several of these latter communications may also have an economic value in the coalfields and in the exploration for metallic cres.

The geologist, however, considers the conditions in past times as well as those at present existing, and opportunities for speculations of this character are supplied by various authors of papers. It were perhaps invidious to select any papers for special mention, but one such discussion of a general nature may be indicated—climates of the past. The subject is by no means novel at British Association meetings, but it is one which may be studied at intervals with profit. Recent researches in geophysics, meteorology, geology, and biology have shed new light on the matter, and an examination of this new evidence should be very helpful at the moment. The relative values of these discoveries may be more easily ascertained in the course of such a discussion than would be possible in other circumstances.

Reference has been made to field excursions. These will take place each afternoon, and in addition two whole-day excursions to cover a wider range of country are arranged for the week-end included in the period of the Leeds meeting The field expeditions form a most important part of the programme of Section C, as they provide opportunity for more intimate discussion than does the lecture room. They also afford greater chances for the junior workers to meet with the more senior people and enable difficulties to be voiced which the greater and wider experience of the senior workers may help to dissipate. In this connexion it will be well to note that the numbers attending these excursions are to be limited in most cases, and a ballot for places may be necessary Early application to the secretaries is therefore advisable.

### SECTION E (GEOGRAPHY).

Polar regions have of recent years assumed a special significance in various fields of earth science. In geophysics and biology, the lands and waters of high latitudes have, by reason of their position, an importance which justifies extended research in these still somewhat maccessible areas. Problems of polar geography form the theme of the presidential address by Dr. R. N. Rudmose Brown, whilst special papers on Greenland and Iceland deal with physical conditions in relation to settlement and development.

Each year brings new evidence of man's triumph over Nature, or rather of man's increasing use of applied science for the extended exploitation of the resources of Nature. The reclamation of the Zuder Zee, which Dr. Jansma will discuss, is outstanding in this respect, whilst even the remarkable physiographic teature of the Great Barrier Reef, the subject of a paper by Sir Matthew Nathan, may one day have an economic value.

The trend of much geographical research in Great Britam has been steadily in the direction of regional interpretation. This finds expression not only in the series of papers on the Leeds region contributed by Dr. C. B. Fawcett and his school, but also in a number of detailed studies of village communities in the Channel Islands, in the mid-Trent valley and in Yorkshire. Physiographic influences, even where they no longer operate, have often left an abiding impress. It is well, however, that other factors contributing to regional definition should occasionally be thrown into strong light, and this is suggested in a paper by Dr. Vaughan Cornish, in which he dis-

cusses the fixation of linguistic boundaries by national adoption of Christianity during the Middle Ages.

#### SECTION G (ENGINEERING)

The presidential address to be given by Sir J B. Henderson to Section G (Engineering) will deal with invention and its dependence upon science. The remainder of the sectional programme includes a variety of subjects of scientific and engineering interest. Dr. T. Stanton and Sir W. B. Hardy are to introduce the subject of lubrication, a topic of great scientific and practical importance. Dr. Lander, Prof. Cobb. and Prof. Wheeler will read papers on various aspects of the coal supplies of Great Britain and their utilisation, a discussion will follow, and it is expected that a number of speakers will contribute interesting matter. This discussion will be followed by a paper describing attempts to utilise the internal heat of the earth for power production

One morning session is to be devoted entirely to papers dealing with the science and practice of electrical engineering. The important questions of supertension cables and switchgear for the transmission and control of large powers are to be discussed: the new jet wave rectifier for the conversion of A C. into D C. by means of a jet of mercury, and particulars of a large-scale plant at present in operation, will be described. A new voltage regulator, in which a valve is used to control the voltage of a D.C. generator supplying current to a laboratory, is to be described, the subject of metallic filament lamps and certain researches in connexion with them will be discussed

Papers dealing with the limits of efficiency of internal combustion engines, the transmission of power by belts, a new type of pump and with many other civil engineering problems are promised. Excursions to engineering works of various kinds in the neighbourhood of Leeds have been arranged.

### SECTION H (ANTHROPOLOGY).

Section H (Anthropology) presents a list of papers which, if not so full as usual, is not less varied. In physical anthropology several communications are of interest to educationists and those in charge of the physical culture of children of school age as well as to anthropologists: Dr. A. H. Mumford will deal with anthropometric observations in relation to school progress; Dr. R. A. Fisher's study of triplets, an investigation undertaken with the assistance of funds provided by the Association, breaks new ground and incidentally brings out deficiencies in our knowledge of the physical characters of the normal child population: and Miss McInnes' ethnological survey of Sheffield and the surrounding districts is based to a great extent on observations of school children and serves to confirm and extend our previous knowledge of the population of Yorkshire. Prof. T. H. Bryce will describe skeletal remains of Viking age from Caithness. An attempt at correlating racial, social, and religious factors will be made by Mr. J. E. Daniels in a communication dealing with Wales. Sir W. Boyd Dawkins will carry further his study of early man and his precursors in the Tertiary

A meeting in the north of England affords an exceptionally favourable opportunity for a survey of recent progress in research in the Roman period. In this field communications dealing with Scarborough, York, and Cawthorn will be received from Messrs. Collingwood, Miller, and Richmond. Dr. Oswald will give an account of his excavations at the Roman Camp of Margidunum on the Fosse Way. A second paper by Prof. T. H. Bryce will discuss the

theory of 'Archaic culture' in relation to Scotland Mrs Cunnington will describe the unique type of prehistoric monument to which she has given the name 'Woodhenge,' and Dr Clay will discuss the evidence for the overlap or the Bronze into the Iron Age in Britain. Messis, Tratman and Taylor will describe the archæology of the Mendips and the Wye valley respectively as the result of excavations carried out by members of the Spelæological Society of the University of Bristol. Dr. T. Ashby supplements the conclusions of his presidential address of two years ago by further evidence relating to the Roman system of communications in the Valley of the Tiber.

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An important and, it is hoped, fruitful discussion will be opened by Dr. H. Frankfort dealing with the question of the early prehistoric painted pottery of the Near and Middle East, which has been found to have a wide distribution in very early times. Of a number of papers in ethnography, mention can be made only of Dr. J. H. Hutton's illuminating study of the significance of head-hunting in the Naga Hills and Mr. G. R. Carline's communication on "Primitive Looms." This latter paper is preparatory to an inspection of the collection of looms at the Bankfield Museum, Halifax, which the members will visit on the afternoon of the same day, at the invitation of the Museum Committee.

## SECTION I (PHYSIOLOGY).

Dr. C. G. Douglas is devoting his presidential address to 'The Development of Human Physiology." For too long the eyes of the experimentalist have been fixed on the 'laboratory animal'-usually the frog-while the clinician has become more and more impatient of the scanty and academical 'truths' offered to him by his laboratory colleague. recent times, however, it has become the practice of certain medical schools and research departments to use man himself as the subject of observation and experiment. The apparatus involved tends to be more costly, the technique is frequently more difficult, but the results amply justify the trouble involved

Prof. H. S. Raper's contribution is especially welcome, in that it promises a simplification of the current views about oxydases. It seems that the time is passing at which a new oxidation is satisfactorily

explained by postulating a new enzyme. There will be presented to the Section the report of

the committee appointed last year to consider particularly the classification of colour-blindness. The signatories comprise Sir Charles Sherrington, Prof. H. E. Roaf, Dr. Edridge-Green, and Dr. Mary There can be no doubt that agreement about terminology is necessary for progress in this matter, and it is to be hoped that the suggestions of this committee will meet with wide acceptance. Other contributions of interest include papers by Dr. W. Cramer on the available supply of vitamin A in relation to the demand, by Prof. J. C. Drummond on the vitamins of yeast, and by Prof. R. J. S. McDowall on the physical concomitants of mental stress, while there is to be a discussion on the circulation rate, with particular reference to its measurement in man.

## SECTION J (PSYCHOLOGY).

The programme of Section J (Psychology) is almost equally divided between topics of general interest and those of obvious practical significance, medical, educational, and industrial. Dr. William Brown's presidential address on "Mental Unity and Mental Dissociation" will probably reflect his own philosophical, psychological, and medical interests. Dr.

T W Mitchell, the editor of the British Journal of Medical Psychology and a prominent figure in the Society for Psychical Research, will contribute a paper on "Phenomena of Mediumistic Trance

Two joint discussions have been arranged, one with Section F (Economics) on "Innate Differences and — Social Status," the other with Section L (Education) on "The Psychology of Special Scholastic Disabilities" Among the papers of educational interest is one by Prof. C. W Valentine on "The Comparative Reliability of Intuitive Judgments in Men and Women," and another by Dr L Wynn-Jones on 'Children's Appreciation of Wit." Representatives of the Industrial Fatigue Research Board and of the National Institute of Industrial Psychology will speak on "Time and Motion Study," "Certain Aspects of Accident Causation," and other psychological topics of industrial importance.

We regret to record the death of Di. Henry Rutgers Marshall of New York, the well-known author of "Pain, Pleasure, and Esthetics," who had accepted the Council's invitation to attend the meeting as a distinguished guest. The abstract of the paper he intended to read on "Self-consciousness and the Selt" will be printed in the Journal and Annual Report and read by his friend Dr. C. S. Myers.

The Section has accepted a condial invitation from Messrs Rowntree and Co. of York to visit their works on Tuesday afternoon, Sept. 6, for the purpose of seeing their methods of selecting and training their workers

#### SECTION L (EDUCATIONAL SCIENCE).

MEETINGS of the Educational Science Section will be held at the Albert Hall on Sept 1, 2, 5, and 6, under the presidency of Her Grace the Duchess of Atholl, M.P. The president will give her address on Friday, Sept 2, at 12 noon, on "The Broadenme of the Outlook in Education," a subject which will no doubt attract a large audience On the same day, at 10 AM, a discussion on "Education in Tropical Africa" will be opened by Sir Theodore Morison with a paper entitled "An Educational Policy for Tropical Africa." Other papers will be contributed by Mr. Rivers Smith ("Education of the African Chief"), Mr Norman Young, Major A G. Church, and Miss S Burstall.

On Thursday, Sept. 1, there will be a joint discussion with the Psychology Section on "The Psychology of Special Scholastic Disabilities" Miss G Hume, Miss I Wheeler, and Miss A H. McAllister will contribute papers on reading, anthmetic, and special disabilities respectively, and an open discussion will follow.

A full session will be given to the subject of "Educational Need of Industry" on the morning of Sept. 5. Mr. J. Wickam Murray will open with a paper on "New Outlooks"; Mr E. Walls will deal directly with the "Educational Requirements of Industry" and Mr. J. H. Everett, Dr. H. Schofield, and Mr. A. P. M. Fleming will discuss "Facilities offered by Technical Colleges," "Engineering Training," and "Non-conventional Types of Education in Industry

respectively. "School Examinations," a subject of much discussion at the present time, will be considered on the morning of Sept. 6. Dr. P B. Ballard, Dr. J. M. Crofts, Mr. B. C. Wallis, and Mr. J. H. Arnold will contribute papers from different points of view, and an open discussion will follow. In the afternoon of Monday, Sept. 5, Sir Henry Hadow will preside at a demonstration of the work of the Leeds Schools Music and Drama League. He will open with a short address and an interesting programme will follow.

## Tidal Predictions by Mariners.1

THE publication of the fourth edition of Part 2 of the Admiralty Tide Tables may well be regarded as a memorable event in the history of practical aids to navigation. The first edition was published in 1858, reprinted annually with amendments and additions until 1909, and subsequent editions were published in 1910 and 1920. Though each edition was an improvement on that which preceded it, the type of information and the method of using it remained in all essentials unchanged. The tidal data were presented in the form associated with the names of Whewell and Lubbock, who were mainly familiar with the comparatively simple types of tide experienced in British waters.

Up to a point, it was sufficiently accurate to state that the high water follows the moon's transit by an interval which is approximately a constant at a given place Such constants have hitherto been the chief aid to navigation in ports for which no daily tidal predictions are available. In many instances it was possible to supplement this method by the use of 'tidal differences'; thus if daily predictions were available at a 'standard port,' then small corrections on time and height could be applied to give fairly good approximations to tidal movements at a neighbouring subsidiary port. It the tidal height at a given hour of the day was required, then tables and diagrams were used, the arguments being (1) the time interval between that hour and the time of high water, (2) the range of tide

The latest edition supplements this information by the harmonic constants of the principal tidal constituents for about a thousand ports, and very strong reasons are given for the use of these constants. It is even indicated that the non-harmonic constants will ultimately be omitted, and mariners are therefore advised to become familiar with the new methods. It remains to be seen whether the process of conversion will be easy, as mariners do not take kindly to new

ways of doing things

The reasons given for the change are of course entirely connected with the degree of accuracy required. The tidal oscillation is composed of a very large number of constituents which may be broadly divided into two main groups, semidiurnal constituents The non-harmonic tidal and durinal constituents constants and the tidal differences can only be functions of either the semiduirnal constituents or of the diurnal constituents It is not possible to include both diurnal and semidiumal constituents in the same constant or difference, and the constants hitherto

<sup>1</sup> "The Admiralty Tide Tables" Part <sup>2</sup> Fourth edition, 1927, containing Non-Harmonic Tidal Constants, Tidal Differences and Harmonic Tidal Constants for the Principal Ports, etc., of the World Published by Order of the Lords Commissioners of the Admiralty Pp 508 (London. J D Potter, 1927.) 3s net.

given have practically been functions of the semidiurnal constituents only. More strictly, they are functions only of the constants of particular constituents, maximuch as the effects of changing phase and distance of the moon are not included, though corrections can be made for these conditions. The tidal differences are more general than the constants, as the variations due to phase and distance are included in the predictions for the standard port In any case where the durnal tide is not wholly negligible, large errors are possible, and the error increases with the relative magnitude of diurnal and semidiurnal tides. In general, the non-harmonic constants and differences are of little value outside the Atlantic Ocean.

For heights of tide at times other than high water, the tables and diagrams assume that the tidal oscillation is simply harmonic. This is never the case where there is diurnal inequality and is very rarely the case for ports situated in relatively shallow water

The harmonic method, however, is uniformly applicable, and its results in general are of very much greater value than those of the non-harmonic methods. The computations required are not excessive, and are facilitated by explicit instructions and tables Carefully worked examples are given, and it is difficult to see how misunderstanding can occur The tables to assist predicting are well set out, and the whole work is straightforward and within the powers of any intelligent man. No knowledge of tidal theory is required. The harmonic constants have been given in such a form that the predictions are automatically rendered in the standard time kept at the place, a feature which is unique to the present publication Since the values of mean sea-level with respect to chart datum are given, the mariner can readily obtain the actual depth of water available; other recent publications of harmonic constants have omitted this important quantity.

Approximate methods of harmonic tidal prediction have been published by Van de Stok for use by seamen, and a recent publication by the International Hydrographic Bureau is based on his work. In Great Britain the movement for reform has been initiated by Commander H. D. Warburg, and it has been backed by scientific opinion. The results of his labours are extremely creditable In the opinion of the writer the list of constants, the mode of presentation, and the instructions exceed anything yet published in this line. This serious attempt to reform the methods of prediction, and the progressive policy of the Hydrographic Department of the Admiralty, are very commendable. It is to be hoped that the methods advocated receive a favourable reception by A. T. Doodson. seamen.

### Studies of Ovarian Dynamics.

PROF. LIPSCHUTZ, in an illuminating review of current work on this subject in Biological Reviews, vol. 2, No. 3, pp. 263-280, gives concrete expression to some of the main results which have emerged from the study of ovarian dynamics In the first place, the author shows that the number of primary follicles which enters into follicular development, the degree of follicular ripening which is attained, and the further fate of the follicle, depend not upon the total number of primary follicles present, but upon general internal factors outside the ovary. This he terms the law of follicular constancy, and there is a constancy for each

Secondly, Prof. Lipschutz shows that the time at

ent upon the age of the internal environment and independent of the age of the ovary. Young ovary engrafted into an adult animal will begin its endocrine activity sooner than corresponds to the age of the ovary, and conversely, adult ovary engrafted into a young animal will cease endocrine activity. The ovary is only the means by which sexual puberty is realised when certain environmental factors allow follicular development and endocrine activity (the law of puberty). The influence of body growth on the ovary is next discussed, and it is shown that certain growth substances, not sex specific, which are necessary for both body growth and follicular

which endocrine activity of the ovary sets in is depend-

development, are not available for the latter so long as there is an intensive growth of organs before puberty.

Finally, the sex specific reaction to the ovarian graft is considered, with special reference to the guinea-pig Here castrated males and castrated females behave differently when engrafted each with an ovary of the same female, the male showing rapid and uninterrupted progressive development to a state of hyper-feminisation, while in the female development is slower and interrupted, with a certain amount of regression, and it never attains the same degree of hyper-feminisation nor is there ever milk secretion. This difference is due, not to somatic differences in the sexes, but to the different behaviour of the ovarian graft. due to some unknown internal factors. The author concludes that general internal factors outside the ovary are of fundamental importance equally with the ovarian hormones, in maintaining a normal sexual cycle.

## University and Educational Intelligence.

BIRMINGHAM.—The transfer of the Zoological Department from Mason College to the new buildings at Edgbaston is now completed. The new quarters, which are spacious and well lighted, include a teaching museum and excellently equipped laboratories both for research and routine teaching of all grades. A good departmental library is provided to meet the needs of research workers. Special attention is to be given to comparative invertebrate physiology, experimental embryology, and entomology (including field work).

Mr. Geoffrey Evans has been appointed principal of the Imperial College of Tropical Agriculture at Trinidad. Mr. Evans was in the Indian Agricultural Service from 1906 until 1926. He was for a time attached to the Queensland Government in Australia as director of cotton culture, and during this period he also worked in Fiji, Papua, and New Guinea.

Some experiments in Indian education are described in a pamphlet (Occasional Report, No. 14) recently issued by the Indian Government Bureau of Education. The Dalton plan has been tried with notable success in high schools at Shillong in Assam and at Dacca in Bengal and adapted with good results to the needs of one-teacher primary schools in Assam. Its success at Shillong is the more remarkable by reason of the multiplicity of vernacular languages used in the school and the lack of anything like adequate accommodation. After four years' trial the teachers are enthusiastically in favour of the new method and endeavour to turn even the periods devoted to class teaching into something more of the nature of conferences of teachers and pupils. Experiments at the American Presbyterian Mission training school at Moza in the Punjab have been directed toward evolving a type of education which will succeed in village schools through relating closely to the pupils' village environment all the work, including the practical farm and domestic training, but in such a way as to tend toward the bettering of present village conditions. The principle of 'learning by doing' and the 'project' method are constantly applied, and great attention is paid to cultivating a capacity for self-help. An account of the introduction of a scheme of medical inspection of school children at Simla concludes with the remark that although a feeling of dismay exists generally in India on account of the present neglected position of this work, yet the Simla Municipality congratulates itself that school medical inspection for its boys is equal to that of any town in the West.

## Calendar of Discovery and Invention.

August 21, 1843.—It was during the Cork meeting of the British Association in 1843 that Joule on Aug. 21 read to "an unwilling audience of six" his paper "On the Calonfic Effects of Magneto Electricity and the Mechanical Equivalent of Heat" From the experiments described he obtained the value of 838 ft-lb. for the mechanical equivalent In a post-script to this paper Joule said that he was satisfied "that the great agents of nature are by the Creator's flat indestructible, and that whatever mechanical force is expended, an exact equivalent of heat is always obtained."

August 22, 1765.—In 1713 an Act of Parliament was passed offering sums of £10,000, £15,000, £20,000 to any one who could discover a method of determining the longitude at sea within 60, 40, or 30 geographical miles respectively. The reward of £20,000 was eventually won by John Harrison, whose fourth timepiece, in the form of a watch about 5 in in diameter, during a voyage in the winter 1761–1762, enabled the position to be determined within 18 miles, and during a voyage in 1764 to be determined within 10 miles. Harrison, however, was treated with illiberality by the authorities, who improperly withheld the reward and imposed new conditions. One of the new conditions was that he should give a full explanation of the principles of his timepiece, which he accordingly did on Aug. 22, 1765, in the presence of Maskelyne and six experts appointed by the Board of Longitude. In spite of this, it was not until 1773, when he was eighty years of age, that the final balance of £8570 was paid to

August 22, 1850—In the Statuary Hall of the Capitol, Washington, D.C., stands the statue of Dr. James Gorrie (1803–1855), a pioneer of artificial refrigeration, who was the first to obtain cold by causing compressed and cooled air to expand in working a piston in a cylinder. Gorrie's patent was dated Aug. 22, 1850. He died at Apalachicola, Florida, and his statue was placed in the Capitol by that State

August 24, 1871.—Helmholtz visited Scotland in 1871, and in a letter to his wife from St Andrews, dated Aug. 24, 1871, he referred to a dinner with Crum Brown the chemist and Sylvester the mathematician. Helmholtz in his letters also gave the amusing sketch of Tait: "Mr. Tait knows of nothing else here but golfing. I had to go out with him. My first stroke came off; after that I hit either the ground or the air. Tait is a peculiar form of savage; lives here, as he says, only for his muscles; and it was not till to-day, Sunday, when he dare not play and did not go to church either, that he could be brought to talk on rational subjects."

August 26, 1856.—While a student and assistant under Hofmann at the Royal College of Chemistry, Oxford Street, Perkin, who was then but eighteen years of age, while experimenting during the Easter vacation of 1856 with the object of producing quinine artificially, was led to oxidise aniline, obtaining as the product the colouring matter known as aniline purple or mauve. The new dye was favourably reported on by Pullars of Perth, and it was patented by Perkin on Aug. 26, 1856. The following year Perkin set up a factory at Greenford Green, with the aid of his father and brother, and from this dates the birth of the great coal-tar colour industry.

August 27, 1783.—The use of hydrogen in balloons was due to the French physicist, Charles, whose trial balloon, 3.9 metres in diameter, was released Aug. 27, 1783.

E. C. S.

## Societies and Academies.

## PARIS.

Academy of Sciences, July 11.—The president announced the death of M. Mittag-Leffler, correspondant in the Section of Geometry—E. Cartan: The Rieman forms of geometries with semi-simple fundamental group.—G. Pfeiffer: Systems of partial differential equations of the first order with several unknown functions possessing the integral of Hamburger—Soula: The comparison of the two functions  $\Sigma a_n z^n$  and  $\Sigma z^n | a_n$ .—Ernest Esclangon: Observations of the partial eclipse of the sun of June 29, 1927, made at the Strasbourg Observatory. The results of measurements of the times of first and second contacts are given. The weather conditions were very favourable.—Th. Moreux Observations of the eclipse of the sun of June 29, 1927, at Bourges— Raoul Ferrier: The limit of application of the theory of the vector potential.—P. Lasareff The law of viscosity of H. Le Chatelier. This formula expressing Viscosity of H. Le Chatelier. This formula expressing the viscosity  $\eta$  of glass as a function of the temperature t, namely,  $\log (\log \eta/\eta_o) = N - Mt$ , where  $\eta_o$ , M, and N are constants, has been applied to the experimental data of Stott for glass, of Thorpe and Rodger for amyl alcohol, and of Deriaguine and Khananov for solutions of sugar in glycerol. The formula applies in all these cases.—Félix Michaud: Binary mixtures of volatile liquids The case where the two components form a compound.—Emmanuel Dubois: The Volta effect. A metal becomes electronegative with respect to its mittal state if it is heated (in a vacuum) to a sufficiently high temperature. The saline impurities which are normally found on the surface of a metal, and probably also in the body of the metal, may take an important part in these variations.—Nicolas Perrakis: The magnetic study of vanadium tetroxide and trioxide; the measurement of the atomic moment of trivalent and tetravalent vanadium. Whilst vanadium in the state of tetroxide possesses within two well determined intervals of temperature two different moments, the one of 8 and the other of 14 magnetons, in the state of trioxide it possesses a moment of 9.5 magnetons. Edgar Pierre Tawil: Some observations in resonance made on piezo-electric quartz.—R. Descamps: The natural rotatory power, in the ultraviolet, of aqueous solutions of the neutral tartrates of sodium, potassium, and ammonium.—L. Andrieux: A new method of preparing boron. On electrolysing at 1100° C. a mixture of boric anhydride (2 mol.), magnesia (1 mol.), and magnesium fluoride (1 mol.) in a carbon crucible with an iron cathode, there is obtained a deposit on the cathode which consists mainly of boron. After powdering, treating with hydrochloric acid and drying in a vacuum, this deposit contains 92 per cent. of boron—Josef Hrdlička. The influence of the preliminary lighting and the disagreement with the law of reciprocity in photography.-Mlle St. Maracineanu: the special effect of polonium, sunlight, and electricity at high voltage on lead. The results of the experiments described suggest that the formation of a new radioactive substance occurs in the lead sheet.—Deslandres: Remarks on the preceding communication. These results are of great interest but very complex, and their exact interpretation requires much additional research.—Albert Portevin and Etienne Pretet: Study of the velocity of solution of the ultra-light magnesium alloys. A discussion of the methods available for measuring quantitatively the rate of solution.—F. Bourion and E. Rouyer: Determination of some complex compounds by the boiling-point method.—Pariselle: The polarimetric and electrometric study of the alkaline aluminotartrates. A double phenomenon of mutarotation.—Charles  $Pr\'{e}vost$  A new class of tautomeric compounds; the onic theory of tautomerism.—Mile Jeanne Lévy and P. Weill: The reality of the semipinacolic transposition The study of anisylmethylethylglycol From the experiments described it is concluded that the transformation of anisylmethylethylglycol into a ketonic product different from that furnished by the aldehydoketonic transposition of anisylmethylbutanal demonstrates the reality of the semipinacolic transposition. In the semipinacolic transposition the ethyl radical shifts more easily than the methyl radical.—Edouard Roch: The western extremity of radical.—Edouard Roch: The Western extremity of the Djebilets massif (Morocco).—P Russo: The presence of Archæocyathus in the Djebel Ighoud (Western Morocco).—V. Agafonoff: The zones of the soils of France.—J. Dufay: The intensity of the green line of the polar aurora in the spectrum of the nocturnal sky.—Edouard Salles: The fixation of the radioactivity of the air by the terrestrial electric field. -Henri Coupin: The carbon nutrition of Penicillium glaucum by means of various carbon compounds of the aromatic series. Compounds of the aromatic series are much less favourable than compounds of the fatty series for securing the carbon nutrition of Penicillium glaucum, and this is probably true also for other moulds —M. Bridel and Ch. Aagaard: Is melezitose a combination of saccharose with glucose? The experiments described do not confirm the view of Kuhn and van Grundherr that melezitose is a combination of saccharose and glucose.-A. Demolon and G. Barbier: Elective ionic absorption in colloidal clay.-Mme Lucie Rabdoin and René Fabre: Comparative researches on the glutathione content of some tissues and blood in the normal pigeon, the under-fed pigeon, and the pigeon deprived of B vitamin.—C. Arnaudi, W. Kopaczewski, and M. Rosnowski: The physico-chemical antagonisms of micro-organisms.

## CAPE TOWN.

Royal Society of South Africa, May 18.—Lancelot T. Hogben: A method for the study of dissociation of hæmocyanin. An elaboration of the method proposed by Pantin and Hogben (1925) for studying the dissociation of the oxyhæmocyanins is described. It is possible to plot a five-point dissociation curve within a quarter of an hour with sera of arthropods and molluses which can be kept indefinitely in the laboratory with prescribed precautions.—Sir Thomas Muir: The theory of Hessians from 1883 to 1914.—S. H. Haughton: Note on some features of part of the Orange River valley. Dealing with the geographical features of the Orange River and its northern tributaries, the gorge-like nature of the valley and its independence of the geological structure of the country were discussed; and the unity of the Great Fish River and the lower part of the Orange was suggested.—A. J. H. Goodwin: Archæology of the Vaal River gravels. Ever since the discovery of diamonds in the Vaal River gravels, stone implements of a large almond-shaped type have been discovered and submitted to various museums, especially the McGregor Museum, Kimberley. The gravels are situated at intervals along the Vaal River, sometimes at a considerable distance from the river, and at various levels above the river bed. They are disjointed, and form various small groups, each of which is a time sequence in itself. The lowest gravels are the latest, and are often in actual process of formation. The highest are probably the earliest. These terraces cannot be dated with any degree of accuracy, but from the fossils discovered we must

regard the earliest (highest) as being of Lower Pleistocene age. The implements appear only in the lower terraces, and must therefore be regarded as of later date than the Lower Pleistocene, owing to the complete lack of such implements in the oldest terraces. These implements are of a type similar to those described by Péringuey as of 'Stellenbosch' type, but the technique approximates more closely to the culture described by Mr. C. van Riet Lowe, from Fauresmith, O.F.S, due possibly to the similarity of material. The Vaal River sites also show that the smaller implements, popularly called 'Bushman,' are of far later date than the large almond-shaped types.—P. R. v. d. R. Copeman Studies in the growth of grapes (Part n.): Relationship between sugar and acid in the juice. There is a very high degree of negative correlation between these two factors. The regression lines are not, however, linear, but the acid may be expressed in terms of the sugar by means of the equation  $(y-a)^n = A/x - B$ , where x and y are the sugar and acid respectively and a is the minimum acidity. This equation is only applicable during the period of decrease of acidity.

#### GENEVA.

Society of Physics and Natural History, June 16 .-L. Duparc: Some chromite deposits of Thessaly. The author has examined several deposits now being worked in the Katarini region as well as the outcrops in the vicinity. These are basic segregations in the serpentinised peridotites.—Amé Pictet and Hans Vogel: The synthesis of maltose. This substance has been obtained by heating in a vacuum at 150° C. a mixture of  $\alpha$ -glucose and  $\beta$ -glucose. At this temperature the a-glucose is transformed into glucosane; the  $\beta$ -glucose is not dehydrated and it forms an addition product which is maltose.-G. Menkès Researches on the action of vitamins on the fungi. Experiments made on various cultures of Aspergillus show that an alcoholic extract of tomato containing vitamin principles, principally factor B, accelerates the growth of the mould and facilitates the assimilation of sugar, in agreement with results of observations made on animals.—M. Hausmann: synthesis of ethyl galactoside in media with different pH The author proves by experiments on the synthesis of ethyl-galactoside by means of emulsm, that the variations of the pH of the medium influence the ferment in its synthetic functions and that this influence is identical with that exercised on hydrolysis. -M. Hausmann: The molecular proportions to be observed in the cresol blue reaction (tyrosinase). In testing for the best molecular proportions for the formation of the colouring matter known as cresol blue produced by the action of the tyrosmase ferment on a mixture of glycocine and paracresol, the author shows that an equimolecular proportion of these two substances is clearly not the best, and that the optimum is attained by a mixture of four molecules of p-cresol with one molecule of glycocine.—Ch. G. Boissonnas and E. Briner: The oxidation of nitrogen by ozone. By experiments carried out at the ordinary pressures and at temperatures between 20° C. and 200° C., as well as in experiments under a pressure of 120 atmospheres, it is shown that ozone is incapable of oxidising nitrogen.

#### SYDNEY.

Linnean Society of New South Wales, May 25.— C. P. Alexander: The interpretation of the radial field of the wing in the Nematocerous Diptera, with special reference to the Tipulidæ. A new interpretation of the radial field of the wing in the Diptera. —Dudley Moulton: New gall-forming Thysanoptera

of Australia. Four new species belonging to four different genera, one of which is new, are described. Miss H Claire Weekes: Note on reproductive phenomena in some lizards. An omphaloplacenta and an allantoplacenta occur in the scincid lizards Lygosoma quoyi, Egernia whitei, and E striolata. The allantoplacentation in L. quoyi more closely resembles that found among the Mammalia than any hitherto recorded in a reptile, there being a partial degeneration of maternal and fœtal epithelial tissue allowing for a close proximity of maternal and feetal bloodstreams. Corpora lutea occur in the ovaries of all the above species and in *Tiliqua scincoides*. The extra-embryonic mesoderm in all four species dips into the yolk-sac endoderm and grows round the yolk-sac embedded in its substance, and not over its surface as is usually the case.-J. McLuckie and A. H K. Petrie. An ecological study of the flora of Mount Wilson (Part iv ) Habitat factors and plant response. The two factors of outstanding significance in controlling the distribution of the vegetation at Mount Wilson are aspect and moisture-content of the soil The Malayan Rain-Forest flora (Ceratopetalum-Doryphora Association) is a mesophytic community which has survived in the most favourable habitats provided by the basalt residuals and the deep sandstone gorges which dissect the area.

Royal Society of New South Wales, June 1.—A. R. Penfold and F. R. Morrison · A critical examination of Eucalyptus dives and the occurrence of a number of varieties thereof as determined by chemical analysis of the essential oils (Part 1.). Three varieties, indistinguishable from the type on morphological grounds, have been determined by chemical analysis.—J. C. Earl: The preparation of tetramethylethylene. A new method utilising several known reactions has been devised. The scheme of reactions is amylene hydrate -> trimethylethylene -> trimethylethylene  $chlorohydrin \longrightarrow dimethylisopropylcarbinol \longrightarrow tetra$ methylethylene. The yield is good, and the process can be interrupted at any stage without risk of deterioration of the intermediate products.—Sir George H. Knibbs: Protogenesis and ex-nuptial natality in Australia The maximum frequency of ex-nuptial births occurred during the period 1899 to 1907; it may be subject to long-period oscillations. The frequency both of nuptial and ex-nuptial cases at the beginnings and endings of the reproductive life, show that both growth and decay are approximately but not exactly exponential. Both commence at about 12 years of age, but the relative frequency, compared with the numbers at risk, is much less for ex-nuptial cases than for nuptial. At age 16.4 the actual numbers are, however, equal. The actual phenomena of nuptial first-births, according to the ages of the mothers, can be represented by three co-ordinates, x denoting age, y denoting the duration of marriage, and z denoting the relative frequency of first-births corresponding to particular ages and durations of marriage. The protogenesic surface discloses the continuity of the phenomena for intervals of less than nine months from marriage with those for all intervals up to 27 years. Fertility varies with age and with time. For births within 9 months of marriage, it was greatest for say 1910.0 and also for 1919.0 for age 21, the numbers for 10,000 women of that age being respectively 1281 and 1248. For all first births it was for age 22 for 1910 0, 23 for 1915 5 and for 1922.5, the respective numbers per 100,000 mothers being 9401, 9363, and 8706. The averages for the year 1917.2 were 1256 and age 21 for births up to 9 months after marriage, and 910 for age 23 for all first births. These are maximum ages and

fertilities The maximum intensity of the gonad urge would appear to be for age 21.3 years both nuptially and ex-nuptially.

#### WASHINGTON, D.C.

National Academy of Sciences (Proc., Vol. 13, No. 5, May).—Joel H. Hildebrand: A quantitative treatment of deviations from Raoult's law. Plotting  $\log N_2$  against 1/T, where  $N_2$  is the mole fraction of the solute, shows that many solvents give with each solute a characteristic group of curves. Dealing with binary mixtures, an extension of Raoult's law is obtained from which several physico-chemical quantities can be calculated —Oliver R. Wulf and Richard C. Tolman The thermal decomposition of ozone. Homogeneous decomposition can be made to proceed so as to be closely of the second order with respect to ozone, the specific rate for different samples may vary considerably but is generally, for ozonised oxygen, inversely proportional to the total pressure. This is considered to be due to the inhibiting effect of oxygen on the decomposition .- C. M. Cleveland · Concerning points of a continuous curve that are not accessible from each other .- O. E. Glenn: Recent progress of investigations by symbolical methods of the invariants of bi-ternary quantics -C. F. Roos: A dynamical theory of economic equilibrium. For equilibrium in a co-operative society, a functional operator must be maximised; for a competitive society, partial maxima of several functional operators must be obtained —Lester R. Ford (1) On the foundations of the theory of discontinuous groups of linear transformations. The concept of the isometric circle of a linear transformation is applied to such groups. (2) On the formation of groups of linear transformations by combination.—Erich F. Schmidt: A stratigraphic study of the Gila-Salt region, Arizona. The ancient pottery falls into three groups, Gila polychrome, black-on-white, and red-on-yellow. The distribution of the sherds with depth in the excavations indicates that the Lower Salt (red-on-yellow) is older than polychrome and was probably made by the builders of Pueblo Grande. The red-on-yellow was synchronous with the black-on-white.—Charles F. Meyer and Aaron A. Levin: The infra-red absorption spectra of acetylene  $(C_2H_2)$ , ethylene  $(C_2H_4)$  and ethane  $(C_2H_6)$ . The range  $3\mu$  and  $15\mu$  was examined and the absorption bands are found to show definite structure. Acetylene has a band (13  $7\mu$ ) showing an intense central Q-branch, an R-branch showing wellmarked alternation of intensity of the lines, and a P-branch with less marked alternations.—G. W. Fox, O. S. Duffendack, and E. F. Barker: The spectrum of CO<sub>2</sub>. A continuous flow method was used A stream of pure carbon dioxide was passed slowly into the discharge tube and subjected to electron bombardment in a force-free space before reaching the filament. None of the bands generally attributed to carbon monoxide was observed. The carbon dioxide spectrum extends from 5000 Å.U. to 2800 Å.U. and consists of bands of various types.—Gilbert N. Lewis: The entropy of radiation. Assuming that radiation can be divided into slices of constant entropy independent of the presence of other slices, and that the chance of a particle being in a selected volume is a linear function of the number of particles already in that volume, Planck's entropy equation is obtained as a first approximation and a further approximation is indicated.—Carl Barus: Linear elements of the electromagnetic pinhole graphs.—Edwin H. Hall: Thermionic emission and the "universal constant" A. An equation for thermionic emission is derived by utilising the dual theory of conduction. In form it is similar to Richardson's equation, but the factor

corresponding to A is variable. - H Bateman . Lagrangian functions and Schrödinger's rule —F. D Murnaghan and K F Herzfeld Two remarks on the wave-theory of mechanics The degree of arbitratiness m the wave-equation and the energy-frequency relation are discussed.—K. T. Compton and C. C. Van Voorhis: Heats of condensation of positive ions and the mechanism of the mercury arc. If neutralisation of the ion occurs at or just outside the surface of the electrode, half the energy is lost by radiation and a portion by reflection. Then the heating of the cathode is given by  $\phi_- = r V_i + L - \varphi_e$ , where  $V_i$  is the heat of recombination of an ion and an electron, L the latent heat of condensation of the neutral gas,  $\phi_s$  the heat of evaporation of an electron, and r is a factor less than 0 5 by an amount depending on the reflecting power of the electrode. In the mercury arc, the electrons are drawn out by the intense space charge (Langmuir) and mercury is lost from the cathode as drops consisting of numbers of atoms -R. J. Lang · Series spectra of silver-like atoms. The first members of each of the four ordinary series for In III., Sn IV., and Sb v. have been identified —J B. Green and R. A Loring: Term-structure and Zeeman effect of the arc spectrum of tin (preliminary report).

## Official Publications Received.

University of Bristol The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1920. Pp 149+8 plates (Bristol) Journal of the Chemical Society containing Papers communicated to the Society July. Pp 1v+1v+1401-1758 (London Guiney and Laglacen).

Jackson Johnson made at the Royal Observatory, Greenwich, in the Year 1927 Astronomy, Magnetism and Meteorology Under the Direction of Sir Frank Dyson. Pp 10+Axxi+A5S+iv+B22+C20+Dix+D47+6+Exxvi+E106+5 plates+18. (London. H M Stationery Office)

Observatory, Greenwich, in the Years 1920 to 1925, under the Direction of Sir Frank Dyson. Pp 58 (London H M. Stationery Office)

Observatory, Greenwich, in the Years 1920 to 1925, under the Direction of Sir Frank Dyson. Pp 58 (London H.M. Stationery Office) 48 bil net
Cape Astrographic Zones, Vol 9. Catalogue of Rectangular Coordinates and Diameters of Star-Images derived from Photographs taken at the Royal Observatory, Cape of Good Hope Commenced under the Direction of Sir David Gill; Completed and prepared for Press under the Direction of Sir Bound Gill; Completed and prepared for Press under the Direction of Sir Bound Gill; Completed and prepared for Press under the Direction of Sir Bound Gill; Completed and prepared for Ceylon Journal of Science Section A: Botany. Annals of the Royal Botanic Gardens, Peradenya Edited by A. H. G. Alston Vol. 10, Part 3, July 1st. Pp 243 319 (Peradenya Department of Agriculture, London Dulau and Co., Ltd.) 3 rupees

Empire Cotton Growing Corporation Report of the Executive Committee, to be submitted at the Meeting of the Administrative Council on July 7th, 1937. Pp 12. (London)

Technical College, Bradford. Diploma and Special Day Courses. Session 1927-28 Pp. 206+26 plates (Bradford)

Aeronautical Research Committee Reports and Memoranda No. 1077 (Ac. 258) Lateral Stability with special reference to Controlled Motion. By H. M. Garner (A.2 a. Stability Calculations and Midel Expts, 121.—T. 2387) Pp. 194-5 plates. 15 net No. 1080 (Ac. 260)

Note on the Reduction of Performance Tests to the Standard Atmosphere. By R. S. Capon (D.1 Special Technical Questions, 197—T. 2398) Pp. 8. 4d net No. 1084 (Ac. 263) A Paradox in Fluid Motion. By Dr H. Lamb. (A.1 a. Dynamical Similarity, etc., 64—T. 2371) Pp. 4. 3d. net. (London + H.M. Stationery Office)

Journal of the Indian Journal of Science, Vol. 10A, Part 1, 1. Some Reactions of Carone, by Kottazath Narayana Menon and John Lionel Simonsen; in. Derivatives of Acenaphthpyridine, Part 1, by Srikumaran Unin Nair and John Lionel Simonsen. Pp. 18. 12 annas. Vol. 10A, Part 2: Oils and Fats from the Seeds of Indian Forest Plants. Part vin The Oil from the Seeds of Acena

Nyasalana Protectorate Geological Survey Bulletin No 3 The L'imestone Resources of Nyasaland, with Notes on the Uses of Lime-stone and on the Manufacture of Lime By Dr. F. Driey Pp. 43 (Zomna) 14. 818

Results of the Meteorological Observations in Tyosen for the Lustrum, 10:21-10:25 Pp 11+52 (Zinsen Meteorological Observatory of the Government General of Tyosen (Zinsen)
Annual Report of the Meteorological Observatory of the Government-General of Tyosen for the Year 19:24 Pp 19:4150 (Zinsen)
New York Zoological Society Report of the Director of the Aquarium Pp 20 (New York)
United States Department of Agriculture Department Bulletin No 1482 Experiments on the Control of the Plum Curculio, Brown Rot, and Scaf attacking the Peach in Georgia By Oliver I. Snapp and C. H. Alden, John W. Roberts and John C. Dunegan, and J. H. Pressley Pp 32 Dequatment Circular 410 United States Standards for Honey, recommended by the United States Department of Agriculture Pp 32 focus (Washington, D.C. Government Printing Office)
Ministry of Agriculture, Egypt Technical and Scientific Service Bulletin No 95 Growth, Bud-Shedding and Flower Production in Egyptian Cotton By M. A. Bailey and T. Trought Pp 40+33 plates (Cairo, Government Publications Office) 5 P. T. Proceedings of the Imperial Academy Vol 3, No 5, May Pp Xixiii + 247-806 (Tokyo)
Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia Verbändelingen No 90 Fest Monocon Engagesting in Java.

Note the Imperial Academy vol 3, No 5, May PP XIXIII—247-806 (Tokyo)

Koninklijk Magnetisch en Meteologisch Observatorium te Batavia Verhandelingen No 20. East-Monsoon Forecasting in Java By Dr H P Berlage, Jr Pp 11-42 (Welterveden Landsdlukkeri))

Abridged Scientific Publications from the Kodak Research Laboratories Vol 10, 1925 Pp 1247-XXVI (Rochester, N Y)

League of Nations Report on the Reform of the Calendar submitted to the Advisory and Technical Committee for Communications and Transit of the League of Nations by the Special Committee of Enquiry into the Reform of the Calendar (Publications of the League of Nations VIII Transit, 1926 VIII. 6) (A.33, 1926, VIII) Pp. 163 Advisory and Technical Committee of Enquiry into the Reform of the Calendar Signature of Proposals for Calendar Reform received before July 1st, 1926 (Publications of the League of Nations VIII. Transit, 1927 VIII. 8) (C. 167, M. 49, 1927, VIII. Annex III. to Document A 33, 1926 VIII) Pp. 58. (Geneva League of Nations; London Constable and Co , Ltd)

## Diary of Societies.

SATURDAY, AUGUST 20

North of England Institute of Mining and Mechanical Engineers, at 2.30 — Annual General Meeting.

#### August 22-26

PATHOLOGICAL AND BACTERIOLOGICAL LABORATORY ASSISTANTS' ASSO-CIATION (in University Pathology Department, Cambridge)

August 22.—At 10 30 A M —W A Mitchell: Cambridge (Lecture).
August 23.—At 9 30 A M —A E P. Grinmo. The Manufacture of Smallpox Vaccine as carried out in the Laboratories of the Shanghai Municipal Council

J. J. Ritchie Antagonism and Symbiosis of Bacteria
Prof G. H. F. Nuttall. The Development of Parasitology.
August 24 — At 9 30 A.M.—S J. Denyer Virulence Tests in the Identification of B. Diphtherce

A. Saunders. Diversions of an Overseas Laboratory Assistant.
J McLean Rare Fæcal Organisms which simulate Pathogens
August 25—At 9.30 A m—F Leeson The Preparation of Plague Vaccine.
S Linfoot Laboratory Work in a Spa Hospital
E. Steele, J. McLean, and others Discussion on Laboratory
Economics.

E. Steele, J. McLean, and others Discussion on Laboratory Economics.

E. C. Haddon: The Biuret Reaction
S. J. Denyer: Difficulties encountered in the Differentiation of Paratyphosus A, B, and C
H. Gooding. On Mounting Frail Museum Specimens on Wax Plates.
V. C. Norfield: Tissue Cultivation Technique.

August 26 -At 9 30 A.M - Demonstrations of Exhibits.

#### EMPIRE MINING AND METALLURGICAL CONGRESS.

Montreal Meetings, August 22 and 23.—Sir Thomas Holland: Proposed Review of the Mineral Resources of the Empire—G M Carrie and C S Pascoe: Magnesia Refractories for Steel Furnaces.—A. Stansfield: Smelting Titaniferous Iron Ores.—W A Toohey. Portland Cement in Canada—Mining and Metallurgical Practice in Australia—Health Safety Problems.

m Canada —Mining and Metalutgical Fractice in Australia —Health Safety Problems.

Toronto Meetings, August 25 ard 26 —C Johnson: Winning and Refining of Precious Metals from Sudbury Ores —R. C Stanley. Nickel, Past and Present —A. A Cole The Silver Mining Industry of Canada — J. G. Morrow: The Cascade Method of Pouring Steel.—A. Mavrogordato and H Pirow. Deep Level Mining and High Temperatures.

Winnipeg Meeting, September 3 —G. E. Cole. The Development of Gold Mining in Canada —W. A. Quince Methods of Eliminating Barren Rock from Ore at the Sub-Nigel Mine—C R. Davis, J. L. Willey, and S. E. T. Ewing: Notes on the Operation of the Reduction Plant at West Springs, Ltd —E J. Laschinger. A New Form of Air Meter and the Measurement of Compressed Air.

Vancouver Meeting, September 14—C. P. Browning Canadian Copper and its Production —F. J. Alcock and T. W. Bingay: Lead and Zinc in Canada.—C. J. N. Jourdan. A Brief Review of the Principal Base Metal and Base Mineral Resources of the Union of South Africa —R Craib: Dewatering the Lower Levels of the Simmer and Jack Mines, Ltd.—W. S. Robinson: Manufacture of Sulphuric Acid by the Contact Process. From Zinc Blende Roaster Gases.

No. 2016 Vict. 1901

Edmonton Meeting, September 20—R Strichan, W J Dick, and R J. Lee The Coal Industry in Western Canada—J Ness Petroleum in Canada—A Docquier, L Bataille, and R Beetlestone A Combination of the Baum, the Draper, and the Froth Flotation Systems as applied to the Washing of Coal at the Linis Mine of the Kailan Mining Administration, North China—A E Cameron Impact Resistance of Street Linis Mine of the Kailan Mining Administration, North China—A E Cameron Impact Resistance of Street Linis Mining Administration of the Kailan Mining Administration of the Mining Min

Administration, North China —A E Cameion Impact Resistance of Steel at Low Temperatures

Quebec Meetings, September 5 and 26 —J G Ross Asbestos Mining and Milling —A W Nash Possible Auxiliary Sources of Liquid Ruel — A Job The Sinking and Equipment of the Ventilation Shaft of the Government Gold-Mining Areas —G W Sharp The Tipping and Guiding of Vertical Skips —P M Newhall and L Piyce Improvements in Duilling Efficiency with Jack-Hammers

Sydney Meetings, September 9 and 10 —F W Gray Mining Coal Under the Sea in Nova Scotia —Sir Robert Hadheld The Metal Manganese and its Properties also, the Production of Ferro-Manganese and its History —Raw Materials for the Iron and Steel Industry in India — B Yaneske The Manufacture of Steel in India, by the Dupler Process Process

#### August 27-September 1

International Congers of Orientalists (at Oxford) In following sections General (including Anthropology, Ethnography, Prehistoric Archaeology, Comparative Mythology, and Folklore), Assyriology and cognate subjects, Egypt and Africa, Central and Northern Asia, the Far East, India and Iran, including the Indo-European Languages of Asia, the Old Testament, the Language, Literature, etc., of Islam, and Oriental Art

#### AUGUST 20-SEPTEMBER 3

INTERNATIONAL COMMISSION FOR THE EXPLORATION OF THE UPPLY AIR (at Leipzig)

AUGUST 31-SEPTEMBER 7

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Leeds)

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Leeds)
Wednesday, August 31, at 8 30 pm —Sir Arthur Keith Daiwin's Theory
of Man's Descent as it stands To-day (Presidential Address)
Thussday, September 1, at 10 am —Addresses by Sectional Presidents
B (Chemistry) —Dr N V Sidgwick Co-ordination Compounds.—D
(Zoology) —Dr. G P Bidder The Ancient History of Sponges and
Animals —E (Geography) —Dr R N Rudinose Brown Problems of
Polar Geography —G (Engineering) —Sir J B Henderson Invention,
—K (Botany) —Prof F E Fritsch. Some Aspects of the Present-day
Investigation of Protophyta.

At 11 am.—F (Economics) —Prof D H Macgregor
tion of Industry —M (Agriculture) —C G T Morison
At 2pm —Conference of Delegates of Corresponding Societies

At  $2 ext{ P M}$  —Conference of Delegates of Corresponding Societies At  $2 ext{ 2 O P M}$  —Discussion (Sections J. L). The Psychology of Special

At 2 30 P.M.—Discussion (Sections J. II). The resychology of Special Scholastic Disabilities.

Friday, September 2, at 10 A.M.—Addresses by Sectional Presidents: A (Mathematical and Physical Sciences)—Prof. E.T. Whittaker. The Outstanding Problems of Relativity—H (Anthropology).—Prof. F. G. Parsons. The Englishman of the Future.—I (Physiology).—Dr. S. C. Douglas. The Development of Human Physiology.—Discussion (Section G). Coal.—Discussion (Section K. M). The Control of Plant

At 11 30 A M —Address by the Pres dent of Section L (Education), Her Grace The Duchess of Atholl The Broadening of the Outlook in

At 8.30 P.M -Evening Discourse by Prof R A Millikan Cosmic

Rays.

Monday, September 5, at 10 a m.—Addresses by Sectional Presidents: C
(Geology)—Dr H H Thomas Centres of Tertiary Volcame Activity
in Britain—J (Psychology)—Dr W Brown Mental Unity and
Mental Dissociation—Discussion (Sections A B). The Structure and
Formation of Colloidal Particles—Discussion (Section G). Lubrication
At 3 30 p m—Evening Discourse by Dr F A E Crew The Germplasm and its Architecture

Tuesday, September 6, at 10 a m.—Discussion (Sections C K, and Cosmical
Physics Department of Section A) Climates of the Past.—Discussion
(Sections F J) Innate Characteristics and Social Differences
At 2 p m—Conference of Delegates of Corresponding Societies

Wednesday, September 7, at 12 noon—Concluding General Meeting. Rays.

Schweizerische Naturforschende Gesellschaft (at Basel) (in 14 Sections) — Presidential Address by Dr F. Sarasin — Lectures on, 1espectively, The Causes and Factors of Molphogenesis, by Prof. A. Brachet, Recent Work and Views in Astronomy, by Prof. L. Courvoiser, The Urals from the Point of View of Geophysics, Geology, and Mining, by Prof. L. Duparc; Paracelsus in Relation to Modern Thought, by Prof H. E. Sigerist

#### SEPTEMBER 3-10

INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS (at Prague)

## SEPTEMBER 4-9

International Congress of Zoology (at Budapest)

#### SEPTEMBER 11-17

International Congress of Physics in Commemoration of the Centenary of Volta (at Como).

#### SEPTEMBER 11-18

International Congress of Generics (at Berlin) In three sections. General Genetics and Cytology, Heredity in Man and Eugenics, Animal and Plant Breeding

#### SEPTEMBER 18-OCTOBER 3.

International Congress of Theoretical and Applied Limnology (at Rome) In four sections: Physics and Chemistry, Geology and Hydrography, Biology, and Applied Limnology



## SATURDAY, AUGUST 27, 1927.

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## The Expert in the Civil Service.

ERTAIN important considerations in connexion with the position of the expert in the Civil Service are raised by the retirement of Sir Frank Baines from the position of Director of Works to His Majesty's Office of Works. Some months ago Sir Frank Baines was approached by a former First Commissioner of Works, Sir Alfred Mond, to undertake the construction of a headquarters on a site in Westminster for the Imperial Chemical Industries, Ltd Sir Frank Baines applied formally for permission to add to his responsibilities in this way, and, following precedent, this permission was granted Later, certain members of parliament discovered that the new building involved an outlay approaching one million pounds, and asked if an architect carrying out such a contract could devote his proper attention to his duties as a civil servant The official reply to the first question, put on May 26, was to the effect that the Government had no right to interfere with the spare time activities of a civil servant, and that this particular contract would not militate against the efficient performance of Sir Frank Baines' official duties. Within a month the Government came to the conclusion that its Director of Works should either cancel his contract with Imperial Chemical Industries or retire from the Civil Service, although, as it was stated by the Government spokesman, Capt. Hacking, there was no suggestion that the work in connexion with the undertaking had so far interfered with the director's official duties.

Now it has been stated on several occasions within recent years that the professional, technical, and scientific staffs in the permanent employment of the State should have their pay and other conditions of service related to those of their professional brethren in outside practice. It was on those grounds that the Anderson Committee reported to Parliament in 1923 that no modifications in the pay or other conditions of service of professional civil servants need be made. Obviously, however, if the case of Sir Frank Baines is to be taken as a criterion, the conditions of service are not the same inside the Civil Service as in outside practice. An outside architect would feel at liberty to increase his practice to any extent, and would be the last person to suggest that he was not capable of undertaking any and every commission offered to him. London is full of monuments eloquent of the efficiency and energy of Sir Christopher Wren. Had the conditions of our time made it possible for Imperial Chemical Industries to invite the Office of Works to undertake the contract for their new building, it is safe to say that no question would have been raised as to the capacity of the Director of Works to do the work without interfering with his other duties.

Without doubt the knowledge gained from long experience in a technical department of State, places the State servant in a position of advantage as compared with the private practitioner. Presumably, it is this knowledge which Sir Alfred Mond wished to put at the disposal of his company, just as the directors of the Bank of England have sought the services of Sir Otto Niemeyer, and the fortunes of Nobel Industries, Ltd. and later of a railway board have in turn been brought under the direction of Sir Josiah Stamp. But a nearer parallel to the case of Sir Frank Baines is to be found in the universities. At one time university professors were rarely consulted by industry or by the Government. Nowadays, largely as the result of the unique services rendered by university staffs to the country during the War, university men of science are being actively encouraged to undertake consulting and research work, for private firms and for the Government. Again, in the Report of the Committee of the Privy Council for Scientific and Industrial Research for the year 1925-1926, special reference is made to the growing volume of work undertaken by Government scientific departments, particularly the National Physical Laboratory, on behalf of industry, and no suggestion is made that the quality of the work of the research staffs suffers in consequence of its increased responsibilities in this direction. Moreover, in the Report of the same committee for the year 1924-1925, reference is made to the increasing volume of consultative work for industrialists undertaken by the State-aided industrial research associations, work which would ordinarily have been done by private consultants.

Not only does the State encourage members of university staffs to undertake additional responsibilities, not only does it compete with the private consultant in industry, but it also appoints State servants to the boards of the State-subsidised industrial research associations in order that knowledge acquired in State departments should be made known and become available to our various industries. Within the past two or three years it has lent scientific workers to some of the great shipping companies to investigate the problems in connexion with the safe transport and

storage of foodstuffs, and wholly maintains State research institutions for the primary object of assisting vital industries.

On account of an organised agitation, however, against the unique knowledge possessed by one of its principal technical experts being made available to an industrial combine, a new attitude seems to be presented to such relationships. The real objection to Sir Frank Baines undertaking a building contract for the Imperial Chemical Industries is based upon the fact that he personally was to profit by the transaction—particularly as the profit was assumed to be large. Neither of the obvious ways of dealing with the situation appear to have been considered The Government could have suggested that the contract should be undertaken officially by its servant on behalf of the Office of Works, and incidentally made it known at the same time that the Government was prepared to tender in the open market for any similar undertaking. Alternatively, it might have given its technical expert sufficient leave of absence to enable him to complete the contract into which he had entered with the full authority of his Furthermore, it might carefully have department considered the desirability of putting the direction of one of its most important technical departments under a man who enjoys the confidence of one at least of the foremost industrial leaders of the time, instead of abolishing his post. Under the present system, however, technical experts in Government service are usually subject to admmistrative officers lacking technical qualifications and experience.

Parliament has been promised that the conditions of service of members of the professional staffs of the Office of Works shall be reviewed. Presumably a Treasury Committee will undertake this task, and an attempt be made to tighten up the existing regulations regarding the nature of any work with which professional civil servants may occupy their private time H M. Treasury is, of course, in a position to impose what regulations it likes, but it may be suggested that in doing so great care should be taken to avoid any semblance of unfair discrimination against a particular section of the Civil Service. What is really needed is the appointment of a Royal Commission to examine and report on the present position of the professional worker in the State service, and to determine what modifications of the Civil Service system, if any, are desirable to meet the changed conditions resulting from the growing impact of the State on industry as a whole.

## The Ascent of Man.

THROUGH the centuries a philosopher here and a naturalist there toved with the notion that man was somehow linked by nature with the animal kingdom, but the notion lacked concreteness and was not taken seriously Then came Charles Darwin, first with a theory of the evolution of organic beings which involved the ancestry of man, and sixteen years later with a cumulative study ( The Descent of Man," 1871) which clinched his argument, and could no longer be Man took his place at the summit of the tree of organic evolution, and as the topmost branch draws the lightning so the ancestry of man became the target upon which were concentrated the thunder-bolts of a fierce opposition Until then, the battle of evolution had been waged upon a long front, but no sooner had the 'origin of man' entered the field than the zone of fiercest combat became narrowed, and to believers in the old creed the descent of man became the salient by the fate of which the whole long front of evolution was to stand or break.

Half a century has come and gone since then: new facts have accumulated and been assimilated. and while evolution has won its battle and become part of the stock-in-trade of the world's thought. a sporadic fight still wages about the isolated salient of man. That it is no mock combat is shown by the numbers of combatants who rushed to the support of the Fundamentalist position in the United States of America a short time ago, and any one familiar with the attitude of mind of the average Briton must be aware of the latent hostility which still survives towards the idea that, in popular phrase, 'man sprang from a monkey,' and of the satisfaction with which the emergence of each new scientific squabble regarding interpretation is hailed as the rift indicating the approaching dissolution of the whole.

At the present moment the critical attitude towards the reality of human evolution is at the top of one of its periodic swings. The reason for the fresh recrudescence of opposition can be easily traced. Charles Darwin's statement of the doctrine of evolution fell upon a scientific world which had been groping for light, and after the first fierce clash with the 'die-hards' of the old order, the grandeur of his concept, its plain logic and simplicity, lulled the scientific world into a stupor of complacency. Biologists accepted the Darwinian revelation; they rushed to weave their fresh examples into its mesh, and with facile interpretation naturalists, profes-

sional and amateur, explained with satisfaction the evolutionary significance of each and every structure as it came to their notice. It must be remembered that Darwin laid the weight of his argument upon the structures of organisms, and passed lightly over the vital problems of functional adaptation and of the correlated development of structures, the prime importance of which is now becoming manifest.

However, the first inhibiting glamour of a great thesis wore off The study, especially of variation, heredity, and the correlation of structures and activities, led to a critical examination of Darwin's conclusions: and while the doctrine of evolution has never been gainsaid, one and another has arisen to show that the course of evolution has not been determined exclusively or mainly by the natural selection or the struggle for existence upon which Darwin laid stress. Two recent works of different character may be cited as illustrating the critical attitude of scientific workers towards natural selection, both, strangely enough, founded upon the study of fishes—Berg's "Nomogenesis" (1926) and Kyle's Biology of Fishes" (1926).

This scientific revolt against the easy acceptance of 'Darwinism' had already gained much ground when it compelled the attention of the people by the publicity given to Bateson's address to the Toronto meeting in 1921 of the American Association for the Advancement of Science, and by the directness and vigour of his attack. The disturbance of accepted theories and ideals by the long years of war had prepared the ground. The popular mind leapt to the conclusion that the apparently established belief in evolution had been shaken, and the critics of the simian origin of man rushed to the fray. Typical of their statements was the contribution of a prominent Boston pastor to an American newspaper, in which he gave the names of "some scientists who at least call in question the loudly asserted proof of evolution," and the names included those of J. P. Lotsv. W. E. Ritter, Paul Kammerer, and E. W. MacBride! Of course, the pastor and his sympathisers were mistaken These men of science had made their declarations with clearness and in full knowledge of the implication of their words. It was only a thoughtless misinterpretation or the blindness of bias which construed their attacks and those of Bateson, Morgan, and the rest, into an onslaught upon the great truth of evolution or descent by modification, instead of, as they really were, critiques of the method - natural selection - by which Darwin supposed evolution to have worked its way. Mistaken though the reading of scientific progress was, it is this mistake which has given new life to the present-day attacks upon evolution, and has induced doubts in many minds, unfamiliar with the trend of scientific achievement, regarding Darwin's view of man's development, and especially of the merging of human ancestry in a common stock with the forerunners of the simina apes.

A restatement of the position in the light of modern knowledge—a simple, convincing statement, unencumbered by detail and side-issues, vouched for on the word of authority—would serve a very useful purpose at the present time glad, therefore, that Sir Arthur Keith has chosen the subject of "Darwin's Theory of Man's Descent as it stands to-day "as the theme of his presidential address to be delivered at the Leeds meeting of the British Association next week. No man is better qualified than Sir Arthur to meet the need of the time-by training, experience, prestige, and by the touch of fervour and imagination which he has carried from northern Scotland. Though the address will be delivered to a body of men and women familiar in the main with the scientific mood and the general conclusions of science, and, enlightening as it is sure to be, can, therefore, scarcely do more than confirm conviction, yet it will reach a wider audience through wireless and the press, and may be expected once again to focus attention throughout the English-speaking world upon the essential verities of man's ascent, and place a fresh strain upon the incredulity of unbelievers.

## Language and Culture.

Die Sprachfamilien und Sprachenkreise der Erde.
Von Pater W. Schmidt. (Kulturgeschichtliche
Bibliothek, herausgegeben von W Foy. Reihe
1: Ethnologische Bibliothek, Band 5.) Pp.
xvi+596. Atlas von 14 Karten. (Heidelberg:
Carl Winter's Universitatsbuchhandlung, 1926.)
42 gold marks.

THIS work falls into two parts, of which the first contains an enumeration of the languages of the world under more or less accepted headings, but an exception to the general rule is made for what are commonly called the Sudanic languages, for which two wholly inconsistent schemes are printed, one by Delafosse, the other by Drexel. The second part consists of a discussion of the distribution of certain features of phonetics, grammar, and syntax, followed by a reclassification of the languages on the basis of the data in question; the primitive position of the dependent

genitive is then dealt with, together with the causes which brought about a change, and finally the relation of linguistic to cultural areas is discussed.

No final verdict can be passed upon the book until specialists for each area have sat in judgment and accepted or rejected, so far as they concern their own special provinces, the theories put forward, but whatever criticism in detail may be launched at the author's head, the work will remain as a great achievement, truly remarkable as the product of one man. Perhaps no one but Pater Schmidt would have had the courage to attempt it, or, if he attempted it, to bring it to a successful conclusion. For the author is far from retraversing well-trodden paths, he has opened a vista of new lines of research which cannot fail to attract many workers.

Where so much turns upon contact between different groups, it is of course essential to have a thoroughly accurate topographical basis for the theories; the linguistic data must be as complete and accurate as possible; and the conclusions must be wholly without ambiguity. To what extent these three essentials have been attained, so far as one area is concerned, will be made clear in the sequel. It is only fair to state that the author in his preface invites criticism in detail and looks forward to a second edition free from the errors which are bound to appear in a pioneer work.

Following Drexel in the main, the author groups Sudanic languages under seven heads: Wule (that is, Ubanghi group), Ngo-Nke (Mande), Manfu (Kwa and Central), Kanuri, Nilotic, Bantoid, and Hausa; in the excellent atlas are shown the areas occupied by these groups and their zones of influence. Unhappily there are serious errors in the territory ascribed to the Mande and Kanuri tongues; Hausa extends three degrees too far north, ghost languages (for example, Gogo and Kandin) appear, and the treatment of the northern provinces of Nigeria is demonstrably almost pure guesswork. Over and above this, Gola is located in the middle of the Kru tongues and Bullom north of Konakry in a Susu area; and a nonexistent range of Bantoid is shown south of the Mande group.

Topographical errors are not confined to the maps; Biafada is in the text located on the Senegal instead of the Rio Jeba, Wolof is put in the Senegal group: Serer, its immediate neighbour, forms with Kisi and Fula a north-east group; but Kisi hes far to the south near Gola, and Fula stretches in a series of groups, mostly small, from a

few score miles from St. Louis in the west as far as Lake Chad. To add to the confusion. Biafada, Serer, and Fula are said to meet the Togoland and Mosi-Grusi groups in the extreme north-east on the upper Niger. But Biafada and Serer are about 1000 miles from Togoland, Fula is not in contact with Mosi on the Niger at all, and the prefixes of Tem have nothing to do with Fula, which is a suffix language. De Martonne's atlas, now in a second edition, appears to have been entirely neglected

When we compare the linguistic data of the text with the maps more errors and serious conflicts emerge; the Wule and eastern Manfu tongues, and all the languages of Nigeria and Kamerun, are shown as making the genitive follow the noun it qualifies, while the subject pronoun follows the verb. But at least a dozen Nigerian languages make the genitive precede, the subject pronoun is almost universally placed before the verb, as indeed the text asserts for Manfu and Wule. The text is also in disagreement with the map as to the location of two languages, Huku and Afo, to which a system of senary numeration is assigned. neither is senary in point of fact, and Huku is near the great lakes, not on the Juba, Afo on the Benue, not the Sanaga. Both text and maps wholly ignore the duodecimal systems of the Bauchi plateau.

It is clear that errors and omissions of this kind go far to compromise the author's conclusions when he proceeds on the basis of linguistic data to define the areas of primitive, primary, secondary, and tertiary speech groups; it may be remarked in passing that, singularly enough, many of the families and groups of the first part of the work have to be split up to make them conform to the new classification.

In Africa the southern primary type includes the Mande and parts of the Manfu, Wule, and Bantoid groups, the northern type includes Hausa and also Kunama, wrongly assigned to the Hamitic family; the middle type is represented by Kanuri and the Manfu group, which thus The secondary type in Africa is appears twice regarded as a product of the southern and middle primary types, it includes Bantu and some Bantoid tongues. Singularly enough, the section on secondary and tertiary languages enumerates among the former Nama and Sandawe, which have previously figured as primitive forms of speech, while Kanuri and Hausa, elsewhere regarded as primary, are also reckoned as tertiary.

Space will not permit the citation of further points in which Pater Schmidt will probably have

to make changes in another edition. It is, however, quite possible to make errors in working out the detail of a theory without invalidating fundamental principles. Attention may now be turned to some of the general principles which the author accepts as axiomatic. In the first place mention may be made of the wide use of psychological arguments in relation to linguistic facts; no doubt, if we could discover the real springs of action, psychology could be made to explain linguistics; but it is quite another matter for a European linguist to argue that because a matter presents itself to him in a certain light, therefore it must be so. The question at issue is one of fact, not of what seems likely.

A case in point occurs when Pater Schmidt is treating of different kinds of gender in nouns; he holds that a two-gender (masculine and feminine) system like that of the Hamitic languages is later than that of the Indo-European languages which have also neuter, as an explanation is given that in the two-gender system feminine and neuter have, for reasons which he sets forth, joined forces and become a single class. If we had no linguistic data on which to go this kind of argument might be admitted, but in Indo-European languages, the primary distinction is between animate and inanimate, that is, masculine and neuter, for these two alone differ in form in the noun, the masculine noun cannot be distinguished from the feminine noun in this way. The obvious conclusion is that the feminine is of late origin.

A second example of this kind of reasoning is found in the passage which explains how the prefix genitive became a suffix genitive. It is put down to the rise of matrilineal or matriarchal conditions, which resulted from the introduction of agriculture; agriculture led to a demand for more land, and this to migration and disturbance of boundaries; the meeting of heterogeneous speech forms resulted in the break-up of both, and from this issued the more logical suffixed genitive. This theory involves a good many assumptions, some of them demonstrably not in accordance with facts. Pater Schmidt's map shows matriarchy and the suffix genitive in south-east Australia, but this was not a result of the domestication of plants, which was unknown. Even more unfavourable for the author's contention is the picture presented by America, where matriarchy seems to be in a great majority of cases associated with the prefixed genitive. The major defect of the argument is, however, the assumption that domestication of plants meant land hunger; for it reduced immensely the area needed by a given number of people for their support.

When we recall how little we know of the origins of Indo-European languages, which in some areas were reduced to writing many centuries ago, it may seem, not without reason, hazardous to survey all the speech forms of the world and explain their relations and transformations. But new ideas have a value apart from their correspondence with facts, and pioneer work like that of Pater Schmidt is deserving of all praise.

# The Nitrogen Industry.

The Atmospheric Nutrogen Industry with Special Consideration of the Production of Ammonia and Nitric Acid. By Dr Bruno Waeser. Translated by Dr. Ernest Fyleman. Vol. 1. Pp. xxv1+330. Vol. 2. Pp. 331-746. (London J. and A Churchill, 1926.) 42s net.

THE original German edition of this work was published in 1923. It contained practically all the information which could be obtained from the literature up to March 1921. It has been the author's intention to make it a standard work by including a large number of economic data and a detailed survey of the literature. Vol. 1 contains a short general introduction and then a historical account of the nitrogen industry in each country of the world. Vol. 2 gives a technical description of the processes used in the nitrogen industry. The author has also included allied processes which may be important from their economic effect on the main industry. There are very complete indexes, bibliography, and list of patents.

In order to bring the first German edition up-to-date for translation, there is at the end of each chapter a supplement containing new matter covering the years 1921–1924, and a foreword of seventeen pages has been written by Dr. J. F. Crowley. The supplements consist, for the most part, of bald references to the literature and make an unsatisfactory ending to each chapter, but Dr. Crowley's foreword successfully summarises the position of the industry.

The importance of nitrogen in commerce arose during the Middle Ages from the use of saltpetre in making gunpowder. The nitrogen problem was as acute in France during the Napoleonic wars as in Germany during the late War. Prevented by the blockade from importing adequate supplies of nitre, France had resource to nitrate plantations (saltpetrières), which were administered by a State department. In these plantations heaps of animal

and vegetable refuse were allowed to rot for months until covered with a layer of saltpetre But after the Napoleonic wars, when swords were turned to ploughshares, morganic nitrogen was not turned to agriculture It was not until about 1840 that Liebig showed that inorganic nitrogen compounds were important soil fertilisers From that time the use of inorganic nitrogen in agriculture has grown steadily. At first Chile nitrate was the sole source of supply; then came, in addition, ammonium sulphate obtained from coal, and within the last twenty-five years synthetic nitrogen compoundsnitrate of lime, cyanamide, and ammonia. The development of the synthetic nitrogen industry took place first where electrical power could be obtained cheaply—principally in Norway, because the arc processes absorbed much electrical energy.

Some years before the War Germany had become anxious to produce synthetic nitrogen fertilisers for her soil. A continental nation with no foodproducing colonies, that country was attempting to produce all the food it required. Tariffs were put on imported food, but Germany had to import large quantities of nitrogen, and in 1913 it absorbed 27 per cent. of the total nitrate exported from Chile, as well as nitrate of lime from Norway and sulphate of ammonia from its own coal industries. During this year (1913), 32 per cent of the world's production of inorganic nitrogen was used by German agriculturists. How different were the conditions in Great Britain with free trade, large investments abroad, food-producing colonies, and a large navy!

When the War broke out, Germany, expecting a short war, appears to have attached no importance to the supply of nitrogen for explosives. Later, when the blockade became serious, Germany looked first to her cyanamide factories for nitrogen, and only later did the German Government realise the possibilities of the Haber Bosch process of ammonia synthesis which had just been established in 1913. Two large factories were erected to provide the war requirements. Since the War the German synthetic ammonia factories have been utilised for the production of fertilisers, and works using somewhat similar processes are now active in other countries -England, America, Italy, France, and Belgium. Some of these (England and America) are well established and are already a commercial success. Others are still passing through tribulations and troubles.

The tendency of modern industry is to build large factories, because greater efficiency is obtained with large machines than with small ones, and the

cost of labour for a given output usually decreases as the size of the unit plant increases But more important still is the advantage of better scientific and technical control of processes which can be obtained in a large factory. Dr. Crowley in his introduction seems to attach great importance to a claim of simplicity of one process (Casale), though it is difficult to find the basis of the claim. He states: "On a visit to an important synthetic ammonia plant paid some twelve months ago, the writer found that the whole plant was being operated under the direct supervision of the engineer responsible for the running of the power station, and that no chemists were employed." It does not seem probable that this plant will long survive in competition with plants controlled by the best technically trained men of to-day.

## An Atlas of Rainfall.

Royal Meteorological Society Rainfall Atlas of the British Isles. Prepared under the direction of a Committee of the Society. Pp. xii +44 maps. (London: Royal Meteorological Society, 1926.) 15s. net.

TIWENTY years ago the collection and publication of meteorological statistics in Britain was divided between the Royal Meteorological Society, the Scottish Meteorological Society, the British Ramfall organisation, and the Meteorological Office. To-day this work is all done by the Meteorological Office, and the preparation and issue of a climatological atlas would be a natural obligation of that institution. But, as Dr. Mill explains in his admirable introduction to the volume under notice, the endowment fund of the British Rainfall Organisation was instituted for the advancement of research in rainfall, and no application of that fund could have reflected more honour on the memory of Symons and Salter (and, one may add, of Dr. Mill himself) than its utilisation for the preparation of an atlas of rainfall Incidentally it enabled the atlas to appear at an earlier date than would otherwise have been likely.

The preparation of a rainfall atlas for a country where the variations are so marked as they are in the British Isles, presupposes the collection and analysis of an enormous number of observations; and above and before all others, credit must be given to the 10,000 observers whose work, for the most part entirely voluntary, during the past sixty-six years provided the material.

The frontispiece of the atlas is a good orographic map of the British Isles, a chart essential for the

right understanding of the maps of rainfall which follow; and to meet a very natural desire, three full-page maps are given showing the average annual rainfall, the rainfall of the wettest year, 1872, and the rainfall of the driest year, 1887. Nearly every patch of colour (high ground) on the orographic map has its corresponding patch of deeper blue (heavy rainfall) on the chart of average rainfall.

There are two main series of maps The first comprises small maps (scale I in 8,000,000) of annual rainfall for each individual year for the fifty-six years, 1868–1923, expressed as a percentage of the average for the standard period of thirty-five years, 1881–1915. An examination of these maps shows that though there were three years (1872, 1877, 1903) in the period with rainfall everywhere above the average; there was only one year, 1887, with rainfall everywhere below the average

The maps show, too, how frequently the regions with the greatest percentage excess of rainfall are not the wet mountainous western districts but the plains and lowlands where the normal rainfall is moderate or low. This series of charts presents a historical summary which cannot fail to interest the student of rainfall, the economist, the water engineer and the reminiscent citizen.

The second series includes twelve full-page maps of average monthly rainfall. Though these are of much greater practical importance than the series of annual maps for individual years, they do not make quite the same appeal to the imagination: averages never do. So it is good that the committee included the annual maps, and it would have been even better, had space permitted, to have had a map for each of the 700 individual months of the period. The reader naturally wants to see if 1872 was as thoroughly disastrous for the farmers of Cheshire, Stafford, Derby, and York as the annual map suggests: that depends on the months in which the 70 per cent. excess in those counties was accumulated, but no information can be derived from the atlas on this point Actually, 1879 was far worse for agriculture than 1872, though the rainfall for the whole year in 1879 was generally much less than in 1872.

The monthly maps reveal many unexpected and interesting features: for example, Norfolk has more rain in July than any part of east and southeast England except the high ground of the Downs. September has a larger dry area than any of the months May to August, but is nevertheless appreciably wetter in the mountainous districts of the west than the months of May to July.

The winter months are relatively very dry in

Cambridge, December being drier than June: in this connexion it is of interest to note that Paris lies in a relatively dry area in France as Cambridge and Oxford do in England

The Table V. of normal monthly rainfall, which Dr. Mill quotes from Mr. Salter's book, reveals that though October is the wettest month in England, December is the wettest month in Scotland, Ireland, and Wales. In Ireland, indeed, August is wetter than October. Similarly though April is the driest month in England, May is the driest month in Wales and Ireland and June the driest month in Scotland.

This atlas, which surpasses expectation and arouses admiration the more it is examined, is really as indispensable a part of the ordinary household reference library as a common topographical atlas, but the price is too high it ought to be reduced to 7s 6d or even to 5s, and the book advertised and sold in tens of thousands, instead of in tens.

E. Gold.

## Alpine Studies and Pictures.

- (1) The Natural History of Ice and Snow: Illustrated from the Alps. By Dr. A. E. H Tutton. Pp xvi+319+48 plates. (London. Kegan Paul and Co., Ltd., 1927.) 21s. net.
- (2) The Art and Sport of Alpine Photography.

  Described and Illustrated by Arthur Gardner.

  Pp. 224 + 150 plates. (London: H. F. and G. Witherby, 1927.) 21s. net.
- (1) DR TUTTON'S work on the Alps is a valuable contribution to the literature on ice and snow. It will appeal in particular to those alpinists who have at least a fair general knowledge of physical science and to those others who visit the Alps of Europe with but the common desire to enjoy a holiday there, and at the same time to see and understand the most striking of the developments of snow, ice, and stream in that marvellous country.

For the latter, the chapter to be read as introductory is Chap. viii, "The Call of the Alps," for there the author sets out the attractiveness of his subject with the enthusiasm of a devotee who has himself spent many holidays in the enjoyment of the physical, mental, and artistic pleasures available in the central area of Europe. These are the lure the reader must have in view when he tackles Part I. of the work, for Part I. is for arm-chair evening reading in advance of a spell of freedom.

Part I. (pp. 1-74) gives a very useful résumé of all the major researches which have gone to build up our present knowledge of the chemistry and physics of water, ice, and snow. Successive chapters deal in detail with the chemical and physical relation of water and ice, the crystal structure of ice and snow, the optical, thermal, and electrical properties of ice, its plasticity, viscosity, and elasticity. Throughout this section Dr. Tutton has treated the subject historically, giving the names of successive workers in the direct line of progress, with dates of their work and an outline of their researches and results. This section of the book thus affords the scientific reader an interesting study of the history of the subject from Cavendish in 1783 to the present day

Referring to Part I. in his preface, the author hopes that it "will be readable by any ordinarily educated person." He is, it is to be feared, too sanguine. The person who has to be taught on p 12 the meaning of  $2H_2+O_2=2H_2O$  is not likely to learn by the time he reaches p 42 enough of physical and chemical science to qualify for the study of Sir William Bragg's 1926 work which is there summarised. Yet the matter of Part I is well selected and carefully written. It gives honour to whom honour is due, and should be read attentively by those who have a fair knowledge of physical science. Taken as a whole it is an interesting study in the record of advance in science

Part II. (pp. 75-146) has a short chapter on the geology of the Alps and a longer one on their topography. The latter should be read in company with a good map. The map given is quite unworthy of the book; in fact it is unworthy of this century. Coolidge's "Alps in Nature and History" (1908) had an admirable map (by Bartholomew), and there are now many excellent maps of the region.

Most of the readers of Dr Tutton's comprehensive work will find its kernel in Chaps. xi and xii., snowcaps, glaciers and their movements; crevasses, bergschrunds, and séracs, dirt-bands and veins; moraines and glacier lakes. These give descriptions and explanations of the phenomena which most arrest the interest of travellers in the Alps, and they are freely and well illustrated by photographs which have been carefully selected from a great store. Chap. xii. outlines the history of the "Conquest of the Summits" It affords answers to many questions which every visitor puts to his friends or his guide-book, and its answers are well and fully stated in an interesting manner.

Part III. (pp. 147-304) presents examples of snow and ice forms discussed in earlier chapters. Here, however, they appear as incidentals to a typical set of expeditions. The expeditions selected were chosen for record as affording the most in-

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teresting illustration of the facts described in the earlier parts of the book, and as being expeditions which the author could describe and recommend from personal knowledge. They are illustrated by 145 pictures on 33 half-tone plates, all being reproductions of the author's own photographs.

These pictures are admirable as illustrations Some are of full-page size, others half-page, but the great majority are six on a page, each of these being about 2 in. ×2 in. Selected with good judgment, they illustrate point after point of interest in the forms of snow and of ice, in the work of frost and of glaciers, and in the scenery produced in the course of prolonged ice action. Each bears definite relation to the text, and the text references to them are complete. Small in size though they are, each makes its point to the eye clearly, yet the execution is such that every one of them stands well the test of detailed examination under a reading lens.

The arrangement of matter in the chapters that deal with definite expeditions is a happy one. It emphasises the individuality of each of the areas traversed and it presents in various settings examples of the different phenomena which in Part II are discussed as types. It is replete with human interest.

(2) In his "Art and Sport of Alpine Photography," Mr. Gardner presents an arresting series of fine photographs—150 plates, six of which have two pictures each, the others are single full-page photographs. These show what can be achieved by skill in the selection of subjects as to each of the many conditions upon which success depends. The author does not, however, leave the pictures and they are pictures—to speak entirely for them-In a light and pleasant running commentary he points to the main factors upon which success depends, and in illustration of the influence of these he refers to the examples in this real album of the Alps which his series of photographs forms. Thus, under "Composition and Foreground" he deals successively with water, trees, rocks, ice, and snow in varied forms. In the following section he deals with weather, lighting, and seasons. In all such matters his work shows that he is exceptionally well qualified to advise those who would produce photographs that are pictures as well as mementoes. In his chapter on mountain portraits, Mr. Gardner points to twenty excellent pictures of the Matterhorn and thirteen of Mont Blanc in illustration of the aspects and moods that go to form what the lovers of a mountain feel as its individuality.

F. G. OGILVIE.

## Our Bookshelf.

Stars and Atoms. By Prof A. S. Eddington. Pp. 127-6 plates (Oxford Clarendon Press; London: Oxford University Press, 1927) 78 6d. net.

This new volume from Prof. Eddington bears the same relation to his "Internal Constitution of the Stars" as does his "Space, Time, and Gravitation" to his "Mathematical Theory of Relativity." It is in the form of three lectures, "The Interior of a Star," Some Recent Investigations," and "The Age of the Stars," with an appendix on the ultimate fate of 'white dwarfs.'

The modern theory of the stars and the way it fits in with and makes use of the modern theory of the atom is a fascinating story, however told But Prof Eddington tells it with the full vigour of a powerful and gifted imagination "Stars and Atoms" is sheer enjoyment in the reading. It is difficult to do justice to the liveliness of his style—the atoms fairly dance before one's eyes—in his own phrase, we see them 'riding sunbeams" His wealth of metaphor is apparently inexhaustible—we have Daedalus and his flying equipment, ballrooms and crinolines, detectives and finger-prints, larders and mousetraps.

Extensive trains of argument are followed through without a mathematical symbol. Prof Eddington is never content with a merely mathematical deduction. He insists that we shall see for ourselves the inwardness of the matter—that we shall not only acquiesce but also give joyful assent. For this reason, and for inspiration's sake, the professional astronomer will profit from this work as much as the general reader. One illustration will suffice. Though not connected particularly with atomic physics, the principle of the Michelson stellar interferometer is described in a way which illumines the whole of optics.

The prospective reader may rest assured that he is not asked to listen to vague speculations. A charm of the book is the author's candidness. Problems are discussed from which present theories are shown to be inadequate. Prof Eddington, a great theorist, shows himself also a disciplined one E. A. M.

Aluminium: the Metal and its Alloys. (A Critical Descriptive Treatise.) By M. G. Corson. Including Chapter on 'Structurography,' prepared in co-operation with J. R. Vilella Pp. xx+291+122 plates (London: Chapman and Hall, Ltd., 1926.) 36s. net.

ALUMINIUM and its alloys are now used very extensively in almost all branches of engineering, and new uses for them are found every year, even in competition with steel. A trustworthy compilation of knowledge concerning them would therefore be of value to the engineer as well as to the metallurgist. This has been attempted by the author of the present work, unfortunately with imperfect success. He has shown great patience and industry in collecting data, but the treatment of

the subject is unsatisfactory, and when information on some point of known technical importance is sought, the statements are too often found to be vague or maccurate. More information as to manufacturing processes would have been welcomed, for such is now to be found scattered through the technical journals, although not as yet systematically collected and reviewed. Diecasting, for example, is used to a far greater extent than would be supposed from the references to it here, and the original difficulties in casting aluminium alloys under pressure have been largely overcome. The imaginary equilibrium diagrams are scarcely a substitute for accurate knowledge, and in fact much more is known of the more important systems than is here indicated. There is much that is of value in the book, and the experienced metallurgist will make critical use of the tables of physical and mechanical data. The photo-micrographs at the end of the volume are of excellent quality, and illustrate the immense improvement in the technique of preparing these rather difficult alloys for the microscope which has occurred in the last year or two

Primitive Man: his Essential Quest. By Dr. John Murphy. Pp. xiv +342. (London: Oxford University Press, 1927) 15s net

THE primitive in man in Dr Murphy's definition is that which characterises him near to his origin as man, that is, when he began to be human, and includes the mind of the savage of the present day who is at a low stage of culture, probably at the intellectual level occupied by early man. His viewpoint in analysing the development of human society from its beginnings in primitive customs and belief to higher manifestations is evolutionary and psychological. In his view, man has progressed by integration through differentiation from the lower to the higher on a line which in a sense is parallel to the evolution of the brain. This, as has been shown by the study of the brain in the anthropoids and fossil man, has been a process of development in the frontal area and a resulting improvement in the powers of co-ordination which have been largely responsible for man's intellectual advancement. Dr. Murphy therefore has a sound physical basis upon which to rest his interpretation of the facts; but it needs no great discernment to see that from the outset he is at odds both with the diffusionist school of Prof. Elliot Smith and with the recently enunciated theories of Prof Levy Bruhl.

A Treatise on Light. By Dr R. A. Houstoun. Fifth Edition. Pp. xi+489. (London: Longmans, Green and Co., Ltd., 1927.) 12s. 6d. net.

The fact that this book has had a new impression or new edition every two years since 1919 is sufficient evidence of its use to teachers and students and of their appreciation of it. The author is to be congratulated in that he has not burdened the student by the introduction of accounts of recent advances in kindred branches of the subject. His

final chapter might well have been omitted, the one valuable addition on the angular diameter of stars being inserted in the chapter on interference. The rest is out of place in the book and in any case could not fail to be inadequate.

An account of modern apparatus for the determination of indices of refraction would have improved the chapter on that subject, and in the chapter on diffraction the accounts of the Lummer-Gehrcke and Fabry-Perot interferometers should have been given in more detail both in theory and practice. The theory would follow very readily from the excellent treatment of diffraction given in this chapter. These are, however, slight criticisms of an excellent treatment of the subject. The reader cannot fail to appreciate the careful mathematical presentation, which is well exemplified in the chapters on lenses, diffraction, and on the nature of light.

The Autobiography of Kingsley Fairbridge With a Preface by the Rt. Hon. L. S. Amery and an Epilogue by Sir Arthur Lawley Pp. x+188. (London: Oxford University Press, 1927.) 6s. net.

KINGSLEY FAIRBRIDGE had an active and adventurous life before he went to Oxford as a Rhodes scholar. Most of the book consists of those early experiences, and gives an admirable picture of Rhodesia in the making. But the importance of the book lies in his scheme of Imperial settlement. Fairbridge was convinced that the solution of the unemployment and emigration problems of Great Britam were to be found in taking children from the large towns and training them in schools in the Dominions to become farmers. His enthusiasm led to the foundation at Oxford of the Child Emigration Society In 1912 he started his farm school in Western Australia. There were many difficulties to be contended with, of which the financial was not the least, but before Fairbridge died in 1924 the scheme was on a sound footing. The book is a worthy record of a man of far-seeing

The Student's Handbook of British Hepatics. By Symers M Macvicar. Second edition, revised and enlarged. Pp. xxxi+464+viii. (Eastbourne: V V. Sumfield; London: Wheldon and Wesley, Ltd., 1926) 24s. net.

THE value of an accurate systematic treatise in stimulating interest in a group is evidenced in the call within a comparatively short time for new editions. Lister's "Mycetozoa," Dixon's "Mosses," and Lorrain Smith's "Lichens" are familiar examples, and to these have now been added Macvicar's "Hepaticæ." The accurate descriptions, useful keys, and excellent illustrations for every species at once made the work invaluable to students, and after fourteen years the stock has been exhausted. The new edition includes only mmor changes; a few additional species, changes in rank of certain forms, and a full glossary being the most important.

## Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

## The 'Forbidden' Line of Mercury at \2270 in Absorption.

In a letter to NATURE of May 28, p. 778, I stated that the line  $\lambda 2270$  which is 'forbidden' by the selection principle for inner quantum numbers, could not be observed in absorption. I have now repeated the attempt with a more powerful instrument, which has been placed at my disposal by a grant from the Council of the Royal Society. A definite positive result has been obtained, the line showing up clearly in absorption by a column of mercury vapour 45 cm. long boiling at a pressure of It is well seen on several different negatives. The range of conditions for observing it is very limited. Too much vapour blots out the continuous background; too little fails to show the line absorp-

The observation seems of considerable theoretical interest, as showing that direct transition from the normal to the metastable excited state of the mercury atom can sometimes occur, even though very rarely. The resonance line of mercury,  $\lambda 2537$ , would. I believe, show up in comparable intensity with the same column of mercury vapour at the atmospheric temperature; thus at about one millionth of the density used for  $\lambda 2270$ .

RAYLEIGH.

Terling Place, Chelmsford, Aug. 10.

## Prof. Labbé's Copepod 'Allomorphs.'

Prof. Labbé, in the succession of papers in which he has expounded his theory of allelogenesis, claims to have established as a fact that, in the salines of Croisic and in the aquaria of his laboratory, an evolution of Copepoda has been observed, leading through a series of eight stages from Canthocamptus to Cyclops. According to his theory, the eggs laid by one species of Harpacticid may produce 'allomorphs' which, according to accepted standards of classification, would be considered to represent distinct genera or even families If such were indeed the case, and it were possible in seven years to observe the transformation of Canthocamptus into Cyclops, it would indeed be necessary for systematists to abandon their task ın despair.

Those who are not specially conversant with the detailed systematics of the Copepoda will appreciate the position more clearly if it were stated in terms of a more familiar group. One may, I think, quite fairly say that it would be much less surprising if the egg of a sparrow were to produce a robin, and the robin's egg a swallow, than if the eggs of a Cantho-camptus gave rise to Wolterstorffia and those of the latter to Copepods having the characters ascribed to Ferroniera. Such revolutionary results are obviously inacceptable, and should not even be considered, unless supported by the most scrupulously exact descriptions and experimental evidence. Prof. Labbé in his most recent paper (Arch. Zool. Exp. et Gen., 66, pp. 135-290; 1927) states (p. 246), "Nous avons maintenant une sériation complète de stades qui donne la preuve de l'arbre généalogique. C'est cette preuve qu'apporte le présent travail," so that

we may suppose that he has now offered all the evidence which he is prepared to give. I have already (NATURE, Sept. 4, 1926) given some reasons why such evidence as he has previously offered is insufficient, and it is only necessary to consider that which is now brought forward.

First, with regard to the descriptions of the 'species' with which Prof. Labbé deals A detailed discussion of each of these would be a long and tedious business and, for reasons which I shall give, it is scarcely practicable or necessary, but one or two cases must

Prof. Labbé does not appear to have availed himself of the most indispensable systematic work on Copepods, Prof Sars's "Crustacea of Norway." Had he done so he would scarcely have redescribed Metis ignea Philippi under the new name of Parametis sanguinea. That the two are identical there can be no doubt, and a comparison of his figures with those of Sars will give some gauge of the accuracy of Labbé's figures in general.

The original parent form of the experimental cultures from which were derived in "huit étapes successives" Wolterstorffia croisicensis, Ferroniera mirabilis, F. cyclopoides, Regis servus, Herouardia paradoxus. Cyclops phaleroides and C. serrulatoides, is called Canthocamptus salinus. This is the species named in previous papers C. minutus O. F. M., but Labbé has recognised that the original identification was unfounded (p. 209). A short description and some figures of this parent form are given which require comment In the first place, the 1st antenna of the female is stated to be of seven "très courtes" joints, but it is figured (Fig. 41) as of seven unusually long joints, the fifth of which bears an æsthete. It may safely be said that this is not the antenna of a Canthocamptus, and indeed I am not aware of any genus or family of Copepod to which it could possibly be referred. Secondly, the first leg of the male and female are shown entirely unlike, and in neither case with an inner seta on the 2nd joint of the exopod I do not know of any Harpacticid showing such an extraordinary sexual difference, and, if the figures are correct, it is quite clear that the animal is not a Canthocamptus, and that two species have been confounded in one description. What these may have been it is impossible to suggest. There is reason also to suppose that the same error, namely, that of giving figures and drawing up descriptions from different species and uniting them under one name, has given rise to others of the remarkable forms here dealt with. It would not be difficult to produce some very striking new creatures by such combina-

If Fig. 103 of the 2nd antenna of Ferroniera cyclopoides male be compared with Fig. 117 of the same appendage of Rhynchoceras rota, a strong suspicion is aroused that in this case the same male has been attached to both species. The appendage as figured is so extraordinary that it could scarcely be identical in two species of different genera. The sexual difference in this appendage is, so far as I know, a new discovery by Prof. Labbé.

It is possible, in some cases, to suggest or to affirm the identity of some of these new species with others already known, but it is not worth while discussing

them all in detail:

(1) The genus Portierella is very extraordinary, and the two species of it in some respects so unlike that they cannot possibly be congeneric if the figures are correct. It seems probable that there is a mixture here too, and that some species of Tisbe forms part of it.

(2) Rhynchoceras rota may, in part, be Tachidius

brevicornis. R elongatus is certainly Euterpina acutifrons, but the "lst gnathopod" does not seem to belong to it

(3) Regis servus is Wolterstorffia confluens Schmeil. It is possible that R racoutzar may be W blanchardi

(4) Herouardia paradoxus certainly includes Halicyclops magniceps, but some of the figures cannot be correct. For example, in no known Copepod is there an exopod on joint 3 of the 2nd antenna, and leg 1 (Fig. 176) has some quite unique characters. Labbé lays great stress on the presence of a spiny operculum in his new species, and, if it actually existed, it is, of course, impossible that he could have been dealing with H. magniceps. On the other hand, he figures it (Fig. 174) on the ventral side and attached to the fourth abdominal somite—a quite impossible situation

(5) Mesquieria cærulescens is Acartia latisetosa

Kric.

It appears, then, that reliance cannot be placed on the accuracy of Labbé's descriptions and figures. Further, if he has in some cases confounded two or more species in one description, it seems that the whole edifice of theory which he has built on his facts must crumble, for the succession of forms on which

it is based disappears.

With regard to the reliability of the experimental methods, it does not seem necessary to say much since (p. 211) Labbé himself admits that no attempt has been made to prevent contamination of the cultures by the introduction of extraneous nauplu. He disposes of this difficulty simply by saying that his interpretation is more probable than that species should always have been introduced in the same order, and by the statement that the allomorphs always appeared in his cultures long before they were "generated" in the salines. On the other hand, we are not told anything about the number of cultures in which this order of succession was observed, or indeed anything whatever about these observations. so that it is impossible to weigh the probabilities. It is very necessary to know more about them. For example, these Harpacticids are minute creatures creeping about in mud and vegetation, and in any culture in which they would be able to thrive it would be most difficult to remove and examine the whole population. They can seldom be recognised except under high powers of the microscope, and without examining the whole, or at least a large part, of the population of an aquarium, it would be rash indeed to say that all the individuals belonged to one species. A very small aquarium stocked as Labbé's seem to have been stocked might readily contain half a dozen species, and it might involve a lengthy examination before all of them were dis-The Harpacticids provide peculiarly bad material for an investigation of this kind.

It is most remarkable that the salines of Croisic should contain only an assemblage of new species and genera and lack so many that are characteristic of such places. For example, no species of Amphrascus is mentioned; no Tachidius; no Mesochra and no Stenhelia. Labbé's identification of Nitocra hibernica is obviously wrong, and there can be little doubt that other species of this genus actually occur. As I have pointed out above, some of these genera were probably actually present and have been described

under other names.

Almost every page and paragraph of this paper provokes criticism, but it seems scarcely worth while to pursue the subject further or to deal with Labbé's views on the systematics and comparative morphology of the Copepoda. They need not be taken seriously. The only question which concerns zool-

ogists is whether or not species at Croisic are giving use by allelogenesis to new species or genera. If this paper contains all the proof which Labbé is prepared to offer, one can say with complete certainty that there is no substantial evidence that such is the case.

ROBERT GURNEY.

Ingham, Norwich, Aug. 3

#### Ectoplasmic Matter.

A PROTEST should surely be made against the statement of the reviewer on page 111 of Nature for July 23 that "various kinds of . . ectoplasmic formation are facts of experience" The number of persons, among those competent to form an opinion, who are of this belief, must be a very small minority, and the supposed existence of ectoplasm is no more proved than that of any other psychic phenomenon

One of the proofs of the existence of ectoplasm relied upon by Dr. Geley in the book to which the review refers are wax masks of spirit hands. As has recently been shown by Sir Arthur Keith and others, these can easily be counterfeited, wax being a substance that readily becomes plastic and capable of fraudulent manipulation at quite low temperatures.

I have, therefore, elsewhere recently made the suggestion that these masks would be more conclusive if made, say, in cast-iron or some other metal which is rigid and nonplastic at ordinary temperatures, but I fear that ectoplasm would frizzle just as easily as the living hands of the mediums or of their confederates, which, I am convinced, are the real agents involved.

A. A. Campbell Swinton

The complete sentence in my review was must now be admitted that the various kinds of lucidity and of ectoplasmic formation are facts of experience as actual, though as sporadic, as hypnotism, insanity, or physical deformity "Mr. Campbell Swinton's protest is interesting, because it seems to mply that all facts of experience must be scientific facts and, inversely, that all scientific facts are common facts of experience. The gist of the review, as well as my previous communications on psychic phenomena (Oct 23, p. 588, and Nov. 13, 1926, p. 693), is to the effect that no 'proof,' in the strictly scientific sense, has been obtained of any supersensible phenomenon. Many 'facts of experience' cannot be explained as yet by exact science, which requires a formula so that the experience may be repeated or prevented at will. Again, much of the phenomena of scientific laboratories are not general facts of experience and are accepted credulously and without understanding by the lay majority. Such common facts of experience, known to the majority as disease, deformity, dreams, and insanity, are admitted to be actual, but they do not, therefore, come under exact science, since the laws underlying these states of matter have not been clearly, that is scientifically, defined. Science has advanced and will continue to advance by discovering the laws underlying all facts of experience, thus bringing the latter under self-conscious control.

Uncommon facts of experience, known only to the minority, are not readily admitted by the majority, for the very good reason that experience is an individual matter. To 'believe' in the reality of another's experience one must have had an analogous experience unless one understands the laws behind or is an undeveloped, credulous person. This is a beneficent law of individual development, and a protection against superstition and charlatanism. On the other hand, we cannot believe that all those who have had experiences unknown to ourselves are fools or knaves.

The man who never dreams does not deny that others

have had such experiences.

It seems to me the duty of science either to show that, in the nature of things, there is no inherent possibility for the existence of ectoplasmic matter, or to attempt a tentative explanation of the phenomena. Blank denial is a foolish policy in the face of rapidly spreading superstitions—spiritistic and religious—amongst the people, many of whom are reacting against the materialistic attractions science has brought within easy reach of the democracy. If the human race is to advance in self-knowledge, science must maintain its authority. What is now termed ectoplasmic matter has always been a concomitant of mediumistic materialisations, and tests suggested to prove its existence are unscientific, for the function of science is not to prove the existence of phenomena, but, when admitted, to investigate and explain it. The first step toward the scientific elucidation of psychic phenomena (and the exposure of superstitious beliefs) is to admit them as facts of experience amongst certain peculiarly organised w. W. L.

# Occurrence of Extensor Rigidity in Quadrupeds as a Result of Cortical Injury.

PERMANENT contraction of certain muscle groups occurs in apes, following the removal of the cortical motor centres of the lumbs. Hermann Munk (1895) stated that 'contractures' do not occur in rabbits, cats, and dogs following similar operations. Recent workers are of the opinion that extirpation of the gyrus proreus of the cat results in an exaggerated extensor tonus in the contralateral limbs, but removal of the motor cortex fails to influence the tonus of the

corresponding limbs.

I observed that removal of the cortical limb areas in cats results in extensor rigidity in the contralateral fore- and hind-leg. If the foreleg area alone is removed the rigidity is confined to the contralateral foreleg; also if the hindleg area alone is removed the rigidity is confined to the contralateral hindleg. In chronic preparations the rigidity has been observed six weeks after the operation. Injury to or removal of the gyrus proreus in cats, in my experiments, does not result in an increased extensor tonus in the contralateral limb muscles, but there is a definite stiffness in the neck muscles.

Extirpation of the foreleg area in rabbits and guinea-pigs results in a marked extensor rigidity in the contralateral foreleg. In chronic rabbit preparations, rigidity has been observed two weeks after

the operation.

The rigidity observed in the animals studied has certain definite properties. It appears very quickly following the operation on the cortex, in the limb muscles which oppose gravity. It can be temporarily inhibited by stimulating reflex movement (flexion reflex and progression). In certain positions (dorsal decubitus) the rigidity exists over long periods of time with no apparent fatigue. In rabbits and cats, labyrinthine and neck reflexes, as described by Magnus and De Kleijn, influence the rigidity in a manner similar to that observed in decerebrate preparations.

It would appear, then, that the rigidity observed in these experiments is due to a release from cortical control and that it is similar to the decerebrate

rigidity as described by Sherrington.

N. B. LAUGHTON.

Department of Physiology, University of Western Ontario Medical School, London, Canada.

## Etiology of European Foul-brood of Bees.

SINCE Cheshire and Cheyne investigated the cause of foul-brood of bees in England and attributed the etiology of the disease to B. alvei, which is almost invariably found in large numbers in infected larvæ, much work has been done to corroborate their results. In no case, however, has an isolated culture of B. alvei been known to produce the disease. On the other hand, G. F. White and others have refuted the claim of Cheshire and Chevne and ascribed infection in this disease to B. pluton. Owing to their inability to cultivate and isolate the organism, however, their claim has remained hypothetical; for it could not be determined whether this organism was itself merely a secondary invader—as they said was B. alvei—or whether the infection was mixed, or whether, indeed, these organisms played any pathological rôle in the

It has been my good fortune, however, to develop a medium admirably suitable for the growth of *B. pluton* (White). A 0·15 per cent. concentration of agar, together with certain nutrients, is employed as an enrichment medium; and a concentration of 1·5 per cent. agar for the isolation of the organism at 37° C. By this method pure cultures of *B. pluton* can be readily obtained, provided the larvæ used contain a preponderance of this organism.

I have obtained infection in a healthy colony of black bees in four days, using as inoculum cultures of the organism derived from isolated colonies. The symptoms of the diseased larvæ accorded with those observed in naturally infected larvæ, and the microscopical picture was typical—B. alvei forms being also present, though only in small numbers. The organism

has been re-isolated successfully.

Morphological studies thus far suggest the identity of the two organisms. While the results in this are not yet complete, cultures of *B. pluton* have been observed to change to *B. alvei* form, resembling biologically the *B. alvei* isolated from infected larvæ. This further corresponds very closely with the changes observed in brood naturally infected, where the ratio of *B. alvei* to *B. pluton* generally increases as the putrefaction of the larvæ progresses, so that *B. pluton* is almost eliminated. The more conclusive substantiation of this is anticipated, and its accomplishment should lead to the demonstration of important relations between the pathogenicity of micro-organisms and their life stages.

Denis R. A. Wharton.

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## Mediterranean Oligochæts.

As our knowledge of the Oligochæta of the Mediterranean is far from being exhaustive, the following records of finds made in Corsica and the Maritime Alps in April last may be of service to future investigators.

1. Microscolex phosphoreus (A. Dugès). Stiff loam, Ville-franche, about 200 ft. Already found in

Sardinia.

2. Enchytræus sp.? Peira Cava, 5000 ft., among the snow; species not yet determined.

3. Eiseniella tetrædra (Sav.). The typical form taken at Thouët (Touët), April 20, and Calacuccia,

Corsica (height, 847 m.), April 27.

4. Eisenia alpina (Rosa). Peira Cava, as before, in perfect condition. On April 2, 1910, I received one specimen from Mr. Wm. Evans, collected in Perthshire. This is at present the only British record; previously reported as occurring in Switzerland, the Piedmontese Alps, Armenia, and Syria.

5. Dendrobæna rubida (Sav.). Peira Cava; one beautiful specimen of this well-known tree-worm.

6. Allolobophora caliginosa (Sav.). Thouet, in a streamlet with Eiseniella as above The same species as the next, but with modifications in the girdle.

7. Allolobophora trapezoides (A. Dugès). In the stream at Calacuccia with Eiseniella.

8. Lumbricus castaneus (Sav ) By stream Thouet, April 20. All the foregoing are British. By stream at

I found a worm (probably A. caliginosa) at Lucéram, but it retreated into a rock-crevice before I could secure it, and so was lost. As my object was to explore the Alps, no time was devoted to the examination of the lowlands and seashore, where, doubtless, a considerable number of species might be discovered, both in Corsica and in the Riviera. Worms are used for angling in Corsica, but no one has determined the species ("The Impossible Island," 82).

HILDERIC FRIEND.

Solihull, July 25.

#### The Tetrad Difference Criterion.

In recent years the quantity F, called the 'tetraddifference', has become very important in psychological investigations as to the possible nature of the underlying causes of mental activities. If there are four such activities, and  $r_{13}$ ,  $r_{24}$ , etc., the six correlation coefficients, F is defined by the equation  $F = r_{13}r_{24} - r_{14}r_{23}$ . The value of F, in practice,

approximates to zero.

On the assumption that the activities are due to the operation of a number N of 'all or none' factors, and that the four activities in question involve the operation of the fractions  $p_1, p_2, p_3, p_4$  of these factors respectively, the most probable value of F is zero, but it is important to know how far we may, a prior, expect it to deviate from zero. In other words, if every possible arrangement of the  $p_1N$ ,  $p_2N$ ,  $p_3N$ ,  $p_4N$  factors out of the universe of N factors be considered, and the tetrad-differences F calculated, we require the standard deviation of F. In the course of investigation the following results have been arrived at theoretically, and without approximations: (1) The mean value of F is zero.

(2) The standard deviation of  $F = r_{13}r_{24} - r_{14}r_{23}$ , calculated on the above assumptions, is given by

$$\begin{split} \sigma_{F}^{2} &= \frac{1}{N-1} \bigg[ \ 4p_{1}p_{2}p_{3}p_{4} \\ &- 2(p_{1}p_{2}p_{3} + p_{1}p_{2}p_{4} + p_{1}p_{3}p_{4} + p_{2}p_{3}p_{4}) \\ &+ p_{1}p_{3} + p_{2}p_{4} + p_{1}p_{4} + p_{2}p_{3} \\ &+ \frac{2(N-2)(p_{1}-1)(p_{2}-1)(p_{3}-1)(p_{4}-1)}{(N-1)^{2}} \bigg]. \end{split}$$

If N be supposed large, and we put the p's each equal to their average p, we have, as an approximation.

$$\sigma_F^2 = \frac{1}{N} \cdot 4p^2(1-p)^2$$
.

JOHN MACKIE.

The University, Edinburgh, July 16.

## The Spectrum of Gold Chloride.

VAPOUR from auric chloride (AuCl<sub>3</sub>) was introduced into a stream of active nitrogen. The observed spectrum consisted of intermingled green bands, shaded toward the old. shaded toward the red. The strongest band heads were measured and found to comprise two systems given by the formulæ:

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A 
$$\nu = 19113 \ 8 + 312 \ 0(n' + \frac{1}{2}) - 382 \ 8(n'' + \frac{1}{2}) - 0.70(n' + \frac{1}{2})^2 + 1 \ 30(n'' + \frac{1}{2})^2.$$
B.  $\nu = 19238 \ 3 + 316 \ 3(n' + \frac{1}{2}) - 382 \cdot 8(n'' + \frac{1}{2}) - 1 \ 45(n' + \frac{1}{2})^2 + 1 \ 30(n'' + \frac{1}{2})^2.$ 
(Half-quanta were not required for the accuracy of the latest that the stress used in raws of the latest decrease.

these data, but were used in view of the latest developments.) The identity of the coefficients of terms in n'' shows a common final vibrational level which is probably the normal state of the aurous chloride

(AuCl) molecule.

Associated with each of the strong heads in the two systems were weaker heads corresponding to AuCl<sup>37</sup>, taking the stronger heads to be due to AuCl<sup>37</sup>, taking the stronger heads to be due to AuCl<sup>35</sup>. In this molecule, for the isotopes of chlorine,  $\rho = 0.9768$ With the dispersion employed (around 28 Å.U. per millimetre), the isotopes of gold were not evident,  $\rho$  for this case being 0 9992. Gold lines at wave-lengths 4792 6, 3122 8, 3029 2, 2748-3, 2676 0, 2641-5, 2428 0, and 2352 7 Å.U. also appeared from excitation of this salt by active nitrogen. The intensities of the band heads in each system follow the usual distribution with changes in n' and n''. In the region 7000 to 2000 Å.U., no other spectrum from gold chloride appeared.

W. F. C. FERGUSON.

New York University, Washington Square College, Washington Square, New York.

#### 'Oertling' Balances.

It is generally admitted that there are few finer craftsmen than the London instrument maker. As employers, therefore, we regret to find a continental

origin ascribed to any of his products.

Since 1849, when the late Mr. L. Oertling settled in London and commenced business as a builder of precision balances, instruments have borne the mark 'L. Oertling—London,' which has, in fact, become known throughout the world as denoting the highest grade of workmanship in this very specialised

It is easily understood that the name might suggest to some a foreign origin; but the truth is that this has never been a foreign firm with a London address, or a firm importing foreign balances, or parts for

Every 'Oertling' balance has been built throughout in London; and, since we find misapprehensions on this point, we wish to stress that our output is entirely British—the product of British brains, British craftsmen, and British capital. MALCOLM DUNBAR,

L. Oertling, Ltd., Turnmill Street, London, E C.1, Aug. 6.

## Petrified Forests.

The interesting note in your number for August 13, p. 239, arising out of Miss Wimfred Goldring's article on the Upper Devonian Forest of Gilboa, N.Y., suggests that readers of NATURE may like to know of the stump of one of these Pteridosperm trees, Eospermatopteris textilis, which was very kindly presented to the British Museum by Mr. Hugh Nawn, president of the Hugh Nawn Contracting Company, and found during the company's work of building the Gilboa Dam. Mr. Nawn informs me that this specimen, and one that he has sent to the National Museum of Ireland, are the only specimens outside the United States.

F. A. BATHER.

(Director).

British Museum (Natural History), S.W.7, Aug. 13.

## Canadian Hydro-Electric Power Development.

By Dr. Brysson Cunningham.

DURING a recent tour in Canada the writer, who had on a previous occasion seen Niagara and the Chippewa-Queenston installation, was able to investigate more widely, though admittedly in a superficial manner, the present stage of hydroelectric power development in the province of Quebec, where he visited power-sites and waterfalls at Shawinigan Grandwing Le Cabella and Mont

Quebec, where he visited power-sites and waterfalls at Shawinigan, Grandmère, La Gabelle, and Montmorency. He also took the opportunity of discussing the situation with officials of the Shawinigan Water and Power Company at Montreal and of the

Water Power Branch of the Department of the

It has been computed that there is some eighteen and a quarter million horse-power of 24 hours availability, and 80 per cent. efficiency, at ordinary minimum flow, in the whole of Canada. Of this, nearly twelve million hp., or say two-thirds, is located in the provinces of Quebec and Ontario, the former having the preponderant share of seven million hp. If the figures be referred to the basis of ordinary six months flow, the total for the Dominion is raised to 32 million h.p. and the proportions of Quebec and Ontario are 11,640,000 h.p and 6,808,000 h.p respectively. The actual water-wheel realisation is fully thirty per cent. in

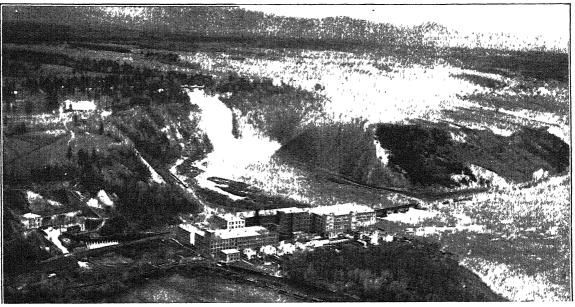


Photo.]

[Fairchild Aerial Survey Co (of Canada), Ltd.

Fig. 1.—Montmorency Falls and Power Station. The Falls are 274 ft high; 114 ft more than Niagara. Reproduced by permission of the Shawingan Water and Power Co.

Interior at Ottawa. The following notes of his observations, combined with information obtained from official sources, may be of interest to readers of Nature

The vital importance of water power to Canada in the development of its industries is a fact not readily appreciated in Great Britain, where water power supplies are relatively of negligible proportions and an abundance of coal for steam driven plant fully compensates for the deficiency. In Canada, the reverse is the case; or rather, to speak with greater precision, it is the case in the more highly developed and most populous provinces of the Dominion, namely, Quebec and Ontario. Neither of the provinces in question is favoured with coal deposits; at any rate, none of economic value has been found, or seems likely to be found: on the other hand, both have numerous waterfalls, most of them capable of development as sources of power at a reasonable and remunerative outlay.

excess of this. These figures give some idea of the vastness of the resources available, especially when compared with the mere million h.p. which represents the total estimated resources of the British Isles. It must not be assumed that the figures, however, are in any sense complete. Indeed, they represent the minimum possibilities. Many rapids and falls in Canada, of greater or lesser power capacity, are scattered over rivers and streams which are not yet recorded and can only become available for classification as detailed survey work is extended and carried out. This is particularly true of the less explored northern districts of the Dominion. Moreover, full consideration has not yet been given to those power concentrations which may be feasible in rivers and streams of moderate gradient with the aid of dams and impounding works. Altogether, it must be admitted that the natural water resources of Canada are of a very high and even stupendous order, amounting on a conservative estimate to fully forty million horse-

Out of the impressive total, whatever it may be, so far the actual utilisable turbine installations established at the present time yield only 41/2 million h.p.—a very small proportion, barely eleven per cent. of the total.

It may be of interest here to insert a full table of the estimated provincial distribution of water power as corrected up to Jan. 1 last, and issued by the Water Powers Branch of the Canadian Department of the Interior.

AVAILABLE AND DEVELOPED WATER POWER IN CANADA (JAN. 1, 1927).

	Available 24-h 80 per cent.	Turbine	
Province.	At ordinary min. flow (h p.).	At ordinary 6 months flow (h p ).	Installation (h.p).
British Columbia Alberta Saskatchewan Manitoba Ontario Quebec New Brunswick Nova Scotia Prince Edward Island Yukon and Northwest Territories	1,931,142 475,281 513,481 3,270,491 4,950,300 6,915,244 50,406 20,751 3,000 125,220	5,103,460 1,137,505 1,087,756 5,769,444 6,808,190 11,640,052 120,807 128,264 5,270 275,250	460,562 34,107 35 227,125 1,790,588 1,915,443 47,231 65,702 2,274 13,199
CANADA	18,255,316	32,075,998	4,556,266

The value of the  $4\frac{1}{2}$  million h.p. already developed may be gauged from the fact that it is found that each installed h.p. is capable of effecting an annual saving of 6 tons of coal, or a total of 27 million tons of coal per annum. With the increasing economies which are taking place in the production of power from coal, this valuation of 6 tons per h.p. will no doubt require adjustment from time to time, but at present it represents a fair and reasonable equivalent. To the provinces which have to import their coal for industrial purposes, the economy is of significant proportions.

It is scarcely to be wondered at, in these circumstances, that the exploitation of available water power sites in Canada is proceeding steadily and even rapidly. To give one example only, five years ago (on the occasion of the writer's previous visit to Canada) the River Saguenay, running from Lake St. John to the River St. Lawrence, was a natural, unregulated stream, flowing through a remote and primitive district. In the interval, some 450,000 h.p. has been developed at Isle Maligne, a station on the river where a fall of about 100 ft. has been utilised, and preparations are now in hand to instal a second power house at Chuteà-Caron, where the fall is 200 ft., with a corresponding availability of power. Works and mills are springing up along the banks, and a new industrial town is projected at Arvida.

During last year (1926) the total horse-power installed throughout the whole of the Dominion was 265,838, but while this is a substantial figure in itself, it fails to take into account many constructional activities which had not reached their final stage. A number of these are nearing completion and will shortly add 1,700,000 h.p. to the Dominion total, while others in active prospect indicate a further addition of at least one million h.p. The capital invested, or involved, in these undertakings cannot be put at a less figure than

270,000,000 dollars.

That progress in the future is likely to be accentuated may be inferred from the consideration that,

DEVELOPED WATER POWER IN CANADA.

	Turbine Installation in H.P.					
Province.	In central electric stations.	In pulp and paper mills.	In other industries.	Total.	Population, June 1, 1926.	Total Installation per 1000 population.
1	2	3	4	5	6	7
British Columbia Alberta Saskatchewan Manitoba Ontario Quebec New Brunswick Nova Scotia Prince Edward Island Yukon and North west Territory	H.P. 318,179 33,520 210,725 1,508,266 1,546,692 25,325 31,942 279	H P. 80,500  174,548 242,044 13,003 16,636	H.P. 61,883 587 35 16,400 107,774 126,707 8,403 17,124 1,995	HP. 460,562 34,107 35 227,125 1,790,588 1,915,443 47,231 65,702 2,274 13,199	568,400 607,000 823,000 638,000 3,145,600 2,561,800 407,200 540,000 87,000	H.P. 810 56 0·04 356 569 748 116 122 26
CANADA	3,684,928	526,731	344,107	4,556,266	9,390,300	485

Column 2 includes only hydro-electric stations which develop power for sale.

Column 3 includes only water power actually developed by pulp and paper companies. In addition to this total, pulp and paper companies purchase from the hydro power central stations totalled in Column 2, horse power estimated at about 425,000 h p., making a total of about 951,000 h p. actually used in the manufacture of pulp and paper.

Column 4 includes only water power actually developed in connexion with industries other than the central station and pulp and paper industries. These industries also purchase blocks of power from the central stations totalled in Column 2.

Column 5 totals all turbines and water wheels installed in Canada.

Column 6, population at June 1, 1928, as estimated by the Dominion Bureau of Statistics.

Column 7 averages the developed water power per 1000 population.

as stated in the Government Report dated Mar. 1 last, the consistent earning power of the various hydro-electric organisations, coupled with the fact that the output of new stations is absorbed almost as soon as it comes on the market, has created a favourable impression in capitalist circles and established a public confidence which is demonstrating itself in the inception of wider and more expansive undertakings. Of the 265,837 h.p. installed during 1926, more than 219,000 h p. was destined for public distribution through the medium of central electric stations. Pulp and paper mill organisations installed 44,760 h.p. during the year, mainly connected to electric generators, and they will purchase a considerable portion of the additional installation of the central electric stations. Installations other than for central electric station purposes and in pulp and paper mills, totalled only 2072 h.p., of which 2000 h.p. was for electrochemical reduction.

The uses to which the existing installations throughout Canada are put, indeed, continue to

follow on general lines the apportionment in the foregoing paragraph. Preponderant, and of growing importance, is the distribution of hydroelectricity through the medium of central electric stations, which account for fully 80 or 81 per cent. of the total. Next comes the pulp and paper mill industry, absorbing about 11½ per cent. of the total power, apart from the large purchases which the mills make from the central stations themselves General industrial enterprises, such as electrochemical reduction, lumber manufacturing, flour milling, grain grinding, water pumping, etc., account for the balance of 7½ per cent.

The table above from the Government report is of interest in showing these allocations, and also the total hydraulic installation per thousand of the population, a feature which bears on the capacity for industrial output of the workers of the Dominion The high average of 485 h.p. per 1000 population enables Canada to assume a position of importance among the nations of the world in per capita utilisa-

tion of water power.

## Some Colouring Agents in Glasses and Glazes.1

By Sir Herbert Jackson, K.B.E, F.R.S.,

Director of Research, British Scientific Instrument Research Association.

BEFORE dealing with the colours and effects produced by ferric oxide in glasses and glazes, let me direct attention first to the different shades of colour which can be seen in varieties of the oxide itself. These range from a reddish yellow through brick reds, bright reds, to a rich brown red and almost to a black. Some specimens also have almost a bronze-like appearance. The range of colours produced when ferric oxide is used as a colouring agent for glasses and glazes is practically as great. It is doubtful if the colours produced by ferric oxide are due to compounds of this oxide with the other constituents of the glass. Without going into elaborate detail it is somewhat difficult to give adequate support to this statement. Perhaps the simplest way of dealing with it is to take the behaviour of ferric oxide in lead glasses, frequently described as flint glasses. There are light flints and dense flints. In the light flints there is always a notable quantity of an alkali such as potash or soda along with the lead oxide. In the dense flints the proportion of alkali is decreased and the proportion of lead oxide is increased.

Now, taking three such glasses as examples, having specific gravities of 3.2, 3.8, and 4.8, it is possible to add a known, but small, quantity of ferric oxide to the first glass and still to produce a glass having no detectable yellow colour to the eye. The same amount of iron added to the second glass will give a noticeable yellow colour, and added to the third glass will give a marked yellow colour. The glass of specific gravity 3.2 contains a notable proportion of alkali, and there is reason to believe that this either promotes the formation of a compound of ferric oxide with the alkali or the

<sup>1</sup> Continued from p. 266.

formation of a double silicate, either sodium ferric silicate or potassium ferric silicate; such compounds appear to be colourless. If the quantity of iron be increased, then a colour can be produced in the light flint, and, by increasing the percentage of ferric oxide to 5 per cent., a fairly strong yellow colour is produced. With 10 per cent. of ferric oxide in the same glass the colour is a deep brownish red when looking through a thickness of about 3 mm. With 20 per cent. of ferric oxide an even richer red colour can be seen when looking through a thickness of ½ mm.; but in thicknesses of 1 mm. or more the glass is practically opaque. When the percentage of iron is raised much higher, some ferric oxide crystallises out from the glass on cooling, and with 40 per cent. of ferric oxide the small crystals dispersed through the glass can be seen with a hand lens. With the denser flints, containing a lower percentage of alkali, colours similar to those described above are produced with much smaller proportions of ferric oxide.

A reasonable explanation of this would be on the same lines as the suggestions made in dealing with cuprous oxide and metallic copper, namely, that the light yellow colour is due to a small amount of free ferric oxide dispersed in the glass as extremely fine particles; the transparent deep yellows and brownish reds would represent a greater concentration of ferric oxide similarly dispersed, possibly also, as the percentage of ferric oxide gets higher, as somewhat larger particles. In the 20 per cent. glass mentioned the particles are still too small to be seen, but in specimens of lead glass containing nearly 30 per cent. of ferric oxide, fine clouds of almost irresolvable particles can be seen in the microscope.

Leaving the subject of lead glasses coloured with

ferric oxide, I would first mention the behaviour of ferric oxide in a glass containing a large proportion of phosphoric acid, an acid which in glasses may be described as a much stronger acid than silica. Ferric phosphate is a definite compound and is colourless, in this phosphoric acid glass, quite a notable proportion of ferric iron may be present without showing any colour. Evidence that the iron is in the ferric state is obtained by heating the glass in a highly reducing atmosphere; this reduces the ferric iron to the ferrous state, and the glass is found to have developed a marked indugo blue colour, due, possibly, to ferrous phosphate, or to ferrous phosphate along with a very small proportion of unreduced ferric phosphate.

In such glasses as ordinary sodium calcium silicates, it is rather difficult to obtain light pure yellow colours with ferric oxide. Much use has been made of ferric oxide in producing glazes which are of a deep colour: practically black in moderately thick layers, though of a fine golden brown in thinner layers. These glazes are frequently described as felspathic glazes, and their composition may be given as sodium or potassium calcium aluminium silicates. To get the deep colour of these glazes, amounts of ferric oxide of the order of about 12 per cent. are required. If the percentage of ferric oxide is raised to about 15-20 per cent. some of the ferric oxide separates out on cooling and, according to the concentration of the ferric oxide, so may be seen a fine brown red colour on the surface of the glazes or bronzelike spangles of ferric oxide, or rosettes, or tree-like crystals, or even more massive crystals which to the eye look black. The Chinese made much use of this behaviour of ferric oxide. As the result of a close microscopic study of certain Chinese glazes owing their colour to ferric oxide, which undertook in collaboration with Mr. A. L. Hetherington, he was able to explain how the varied and beautiful effects seen on certain specimens of Chinese porcelain could be obtained, and to show many similar glazes produced in the laboratory to support the explanation put forward.

Ferroso-ferric oxide, magnetic oxide of iron, gives in certain glasses neutral tints of various depths, but with high concentration of this oxide a black glass can be obtained. If the concentration of the ferroso-ferric oxide be high enough, some of this oxide will come out on cooling so as to be dispersed through the glass in very minute aggregations, which are, however, presumably crystalline, since the resulting glass is appreciably magnetic. The above remarks refer to glasses containing the whole of the iron in the ferroso-ferric form. ferrous iron glass or glaze contains some ferric iron, the green colour due to the ferrous iron will be modified and various olive green tints can be obtained. There are many such coloured glazes in which the iron is principally in the ferrous state, but there is sufficient of the ferric iron present to produce the olive green tint. In a similar way small quantities of ferrous iron in a glass which contains appreciable quantities of ferric iron will

modify the yellow or brown colours due to the ferric iron and give somewhat dusky hues.

Before leaving the subject of iron I am tempted to hazard a guess at the nature of the colouring matter in lapis lazuli. In almost all the specimens which I have seen, here and there crystals of iron pyrites (ferric sulphide) can be seen. An examination of these specimens under the microscope reminds me very strongly, except for the difference of colour, of the appearances of many of the glazes very deeply coloured with ferric oxide, in which also crystals of ferric oxide can be seen. The colouring of lapis lazuli is very intense, so much so that very thin portions of it make equally thin portions of the deepest blue glass obtainable look almost white by comparison Let me for a moment direct attention to a simple experiment with solutions. If to an aqueous solution of ferric chloride, as free as possible from free hydrochloric acid, there be added quickly an aqueous solution of hydrogen sulphide, there is the production of a transient intense lapis lazuli colour. It has been suggested that this colour is due to the formation of a ferric sulphide which, in the solution, rapidly breaks down to a ferrous salt with the separation of free sulphur. My guess in respect of lapis lazuli is that the beautiful blue colour is due to minute particles of ferric sulphide, altogether too small to be seen by the microscope, dispersed through the mineral. Different concentrations of the dispersed ferric sulphide would account for the various lighter blues, full blues, and dark, almost black, blues which can be seen in specimens of lapis lazulı. I hope to be able to find a specimen of lapis lazuli of the very blackest blue colour obtainable and to examine it critically by the microscope; I also hope to be able to test the suggestion made by synthetic experiments.

In the process of making artificial ultramarine by heating together clay, sodium carbonate, sulphur, and charcoal, or some other substance rich in carbon, it has been stated, I believe, by a number of experimenters, that small amounts of iron must be present in the materials. I need scarcely mention that almost every clay contains

small, but appreciable, quantities of iron.

A few points about the third colouring agent already referred to may now be described. It is quite a common thing to see glass in windows which by long exposure to sunlight has developed colour ranging from a pink, through various depths of rose-violet almost to a marked blueviolet. Some window glasses also become coloured with a brownish-yellow tint by long exposure to sunlight, but the colour is not usually noticeable. In a glass sphere taken from a sunshine recorder, kindly lent me by Dr. G. C. Simpson, the originally colourless or slightly green glass has become a pronounced yellow-brown; the colour of this sphere is very marked in comparison with the usual colourless sphere.

The colour developed in a glass by exposure to sunlight is partly determined by the composition of the glass. Similar discoloration can also be produced in glasses by exposing them to ultra-

violet rays of shorter wave-length than those present in sunlight, to X-rays and to the radiations from radium, but the colour developed by these agencies is not, in every instance, the same as that which can be produced in the same glass by exposure to sunlight. There can be little doubt that the radiations are the cause of the colour, though what is the nature of the material which is separated out by the action of the radiations and produces the colour is not fully known. In purpled window glass, manganese has been frequently mentioned as the colouring material, it being sometimes assumed that under the influence of the radiations the colourless manganous oxide in the glass becomes oxidised to a purple manganese peroxide. In a similar way it has been suggested that the brown colour such as is seen in the sunshine sphere is to be explained by the oxidation of the ferrous iron to the ferric state. There are certain difficulties in accepting these explanations of the colours. The colourless sunshine sphere mentioned above was, a few weeks ago, a much darker vellowbrown than its companion which shows the marked brownish-yellow colour. Both spheres were colourless when new, and the present colourless one has been rendered so by heating it to a temperature All the varieties of coloured glass with which I have been able to experiment, and which owe their colour to the action of radiations, can similarly be decolorised by heating to an appropriate temperature; but of all the glasses I have tried which have been purposely coloured by ferric oxide, or by manganese dioxide, I know of no example which can be decolorised by heating, even if it is heated up to a temperature sufficiently high to re-melt it. This is not to say that these observations refute the suggestions of the nature of the colour mentioned above, but they certainly introduce difficulties which it would take too long to elaborate on this occasion.

Just as glasses can become discoloured by radiations, so have many minerals apparently been similarly affected, and in all examples which I have tried, and in which the colours were produced presumably by radiations, the colouring could be discharged by heat. Highly coloured fluorspar is a typical example; purple amethyst, smoky quartz, rose quartz, yellow quartz, and various coloured zircons, known in the gem trade as jargons, are others. All of these can be decolorised when heated to an appropriate temperature. A fine purple amethyst, for example, became clear colourless quartz at a temperature of about 400° C. A rather browner purple amethyst lost its purple at the same temperature, but had a yellow colour left, which was discharged, however, at 700° C., and the resulting quartz was white but not clear; it was opalescent.

In all the cases mentioned above it is found that when the colour of the glass or mineral is discharged by heat, the apparently colourless material shows a marked absorption in some part or other of the ultra-violet spectrum.

In the instances of glasses and fluorspar it is generally found that the decolorised specimens

exhibit marked fluorescence under the influence of ultra-violet light. I have not seen examples of crystalline quartz which show similar fluorescence, but if the decolorised amethyst be fused, the vitreous silica so obtained shows marked fluorescence Either the decolorised amethystine quartz or the same substance fused can be coloured again by exposure to radiations, the colour being developed most readily by exposure to the gammarays of radium. It is not possible, with pure crystalline quartz, which shows the highest transparency to ultra-violet radiations, to produce any coloration by submitting it to the action of the gamma-rays from radium over a period sufficient to produce marked coloration in the decolorised amethyst or in decolorised rose, yellow, or smoky quartz. Similarly, I have not found it possible with fluorspar of the highest transparency to ultra-violet light to colour it by gamma-rays, but there are many specimens of fluorspar colourless to the eve which fluoresce in the ultra-violet light, and these can be coloured by exposure to the gamma-rays from radium.

From all the observations it certainly seems that the substances I have mentioned owe their colour to the action of radiations, and become coloured only when they contain a small quantity of a suitable impurity. There is no conclusive evidence of the exact nature of the material which, separated out by the action of the radiations, imparts colour to the glass or mineral Finely dispersed metal such as calcium has been thought possible as accounting for the colouring of glass, fluorspar, and Iceland spar, but glasses which contain no calcium become coloured by radiations, and it is not impossible to imagine finely dispersed potassium or sodium as the colouring material. Silicon itself has been suggested as producing the colour of some quartz, and so has titanium, and so has carbon. It is difficult to see why silicon, which is made to go back as silica by heating, should render the quartz opaque to some ultra-violet radiations. There is no suggestion which has been made which is not open to some objection or other.

In the production of these colours, there appears to be some analogy with the ordinary changes which are observed in silver salts on exposure to light. A pure silver halide (chloride, bromide, iodide) is apparently unaffected by light. That the well-known action of light on these compounds as they are generally prepared is ascribable to the presence of small quantities of some other material or materials is generally accepted; but no one would suggest with our present knowledge that the dark material which develops in the silver salt when exposed to radiation consists of the impurity. The darkening is ascribed to decomposition of the silver salt, which decomposition is rendered possible by the presence of the impurity.

Taking into account all the observations which have been made on the effect of exposing various glasses and minerals to radiations and to cathode discharge, it would appear not unlikely that the colours produced in these experiments are ascribable to the separation from the material of one or other of its constituents by the action of the radiation, which separation is only possible provided there is present in the material a suitable impurity; but change the line of argument a little, and there are facts which would appear strongly to support the view that it is the impurity itself, in many instances, which becomes separated out in a fine state of division by the radiations and imparts the colour to the glass or mineral. We do not know. There is a mass of evidence to be considered, but much more experimental work is needed before that evidence can be dealt with and properly assessed.

## Hæmolysis.

THE discussion at the recent meeting of the British Medical Association in Edinburgh, opened by Dr Eric Ponder, afforded much information as to the nature of hæmolysis, and was particularly fruitful in clearing up the apparently contradictory data concerning the structure of the

erythrocyte or red blood corpuscle.

On one hand, it has been held that the red blood corpuscle, although to all appearance homogeneous, in reality consists of an external envelope of colourless material which forms a thin film enclosing the dissolved coloured material or hæmoglobin. Thus this envelope would be controlled by the laws of osmotic pressure. When water reaches the corpuscle it passes through the film and swells the corpuscle, causing it to become globular; eventually the envelope will burst or become sufficiently distended to allow the fluid to escape through its pores, the envelope being left. The loss of water from the cell causes shrinking and corrugation of the surface, the wrinkled or crenated form being produced. On the other hand, it has been supposed that the corpuscle is formed of a homogeneous porous material, in the pores of which the hæmoglobin is contained.

A few years ago a reversal effect was described by Brinkman, but the reaction is only apparent. After hæmolysing the cells, the solution was centrifuged and the supernatent fluid subjected to cataphoresis. This treatment resulted in the appearance of the ghosts at one pole and of the hæmoglobin at the other; on mixing the ghosts and hæmo-globin together the cells were apparently reformed, but on analysis only 50 per cent. of the hæmoglobin could be accounted for. Further, it can be shown that the isoelectric point of the normal cell and that of hæmoglobin are different, whereas the isoelectric point of the re-formed cell and hæmoglobin are the same, which is evidence that in this phenomena the cell is not re-formed as was originally thought, but that the hæmoglobin is merely adsorbed on to the surface of the ghost.

The further evidence advanced by Brinkman, that section of the red cell does not result in the exudation of fluid, is by no means contradictory to the theory of the envelope-like structure of the cell, for indeed, as Schafer pointed out, it is possible to cut a soap bubble in a similar manner, the razor

reuniting the edges of the cut membrane.

The changes in size and shape which the cell undergoes both in hypotonic solutions and in solutions containing hæmolysins afford considerable evidence that the red cell of mammals is a balloonlike structure possessed of an envelope of consider-

able strength. The work of Seifriz offers direct information. This observer has actually microdissected the human red cell, stretched its envelope, and observed the escape of fluid containing hæmoglobin from the cell. The membrane is probably similar to that suggested by Beehold, namely, that it has a protein frame-work in the interstices of which lipoids are contained. It is probably maccurate to describe the lipoids as a constituent of the cell membrane; for recent work goes to show that the lipoids are mainly if not entirely within the cell. Mellanby, in the discussion, raised the objection that the cell membrane could scarcely be of a protein and lipoid structure, as the enzymes lipase and trypsin are without hæmolytic action upon the red cell. In this instance the specificity of enzyme action must be remembered; and, further, Ponder has shown that certain proteolytic enzymes of bacterial origin are capable of

producing hæmolysis.

The ingenious method devised by Mellanby has afforded a means of making rapid and accurate observations on hæmolysis. A beam of light passes through a system of lenses, the emerging parallel rays being incident upon one of the parallel faces of the glass cell containing the suspension of corpuscles. The beam of light, after passing through the suspension, falls upon a selenium cell which is connected in circuit with a galvanometer. Variations in the intensity of light passing through the suspension of corpuscles produce variation in the deflexion of the galvanometer. The galvanometer scale is calibrated so that the readings may be made direct in terms of hæmolysis. To keep the experimental conditions constant, the parallel-faced dish is surrounded by a water bath, the temperature of which is kept constant by an electric thermo-regulator.

Using this method, Ponder has shown that a large number of lysins fall into what might be called the class of simple hæmolysins. With this class of lysins, hæmolysis results in the using up of the lysin due to its union with some protein component of the cell envelope, the reaction being of the first order. Among this simple class of hæmolysins are the majority of the hæmolytic glucosides, the soaps, salts, and acids allied to the bile salts; while recently McLachlan and Ponder have shown that the majority of the lysms of bacterial origin fall into this class. It is very interesting to note that two of these bacterial lysins, namely, that of B. histolyticus and that of Streptococcus pyogenes, are definitely known to be

proteolytic.

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With the lysins of the saponin class, the reaction which results in hæmolysis appears to be one between the lysin and the protein of the cell envelope, and it is possible to demonstrate that these lysins will unite with other proteins to form nonhæmolytic compounds. Further, the results indicate that the combination takes place as an adsorption process. An interesting point arises with regard to the action of bile salts, as it has been shown that the serum proteins may either inhibit or accelerate the action of the bile salts according to the order in which the components of the hæmolytic system are added. The inhibitory action may be explained in the same manner as the saponin series, but the manner in which acceleration is brought about is far more difficult.

Mackie's experiments on brilliant green are of interest in this respect. 'Brilliant green' in high concentrations is a hæmolysin, but in lower concentrations it acts by 'sensitising' the cells so that the subsequent addition of small quantities of serum produce rapid lysis Further, as in the bile salt system, if the components are mixed together in the reverse order, no hæmolysis occurs. Although the sensitised cells are apparently free !

from 'brilliant green,' in reality they contain large quantities of the dye, as is evidenced by extraction with alcohol and acetone. Experiments have shown that the dye is united to the hæmoglobin as well as to the cell envelope, and that the amount taken up is nearly proportional to the amount used in bringing about the sensitivity. The reaction between the 'brilliant green' and the cells is divisible into at least two distinct changes:

(1) The adsorption of the dye by the cell en-

velope and contents.

(2) A reaction, which results in hæmolysis, occurring between the adsorbed dye and the cellenvelopes.

The amount of lysin formed will depend on the amount of dye adsorbed to the cell and the amount of protein added. If one unit of 'brilliant green' is adsorbed to the cells, this unit will unite with one unit of serum to form one unit of the new lysin. If only half a unit of protein is added, there will be insufficient protein present for the combination and one half unit of lysin will be formed. The phenomena observed with the bile salts can be shown to be identical with those observed with ' brilliant green,' the taurocholate replacing the dye as a 'sensitising agent.'

## The Leeds Meeting of the British Association

Local Arrangements.

EEDS, in these days of railway amalgamations, is supplied with railway termini in confusing profusion, the LM.S. trains arriving at no less than three different stations. All the stations are close together, however, and convenient for the reception rooms. At all stations members will be met by guides wearing armlets, and those proceeding to hostels can, if they wish, entrust their luggage to these officials for despatch to the hostels.

The inaugural meeting, where the presidential address will be delivered, is to be held in the Majestic Cinema, which lies between these main

stations, and faces on City Square.

The abundance of restaurants near the city has obviated the need for extensive provision for meals in the Reception Room, but lunch or tea can be obtained there, whilst at the University, in addition to the usual refectories, a buffet luncheon will be served in the elementary physics laboratory throughout the week.

The local handbook is now ready for distribution to members. Under the editorship of Dr. C. B. Fawcett, this handbook is more on the lines of modern regional geographic studies than has been customary. A special feature of the meeting is the series of guides to the various excursions, which are gathered into a neat cloth folder making another volume equal in size to the handbook. Under the editorship of Mr. H. E. Wroot, these excursion handbooks have been done with unusual thoroughness, and will be found of permanent

Members will also receive a guide to the extensive exhibition of scientific apparatus in the Crypt of

the Town Hall, whilst the local handbook contains brief descriptions of the special exhibits by the Air Ministry and Meteorological Office, and the British Broadcasting Corporation, which are also in the Town Hall, and of the demonstration of television, noctovision, and the phonoscope which is to be given by Mr. J. L. Baird in a room at the Education Offices next door to the Town Hall.

The General Committee, the Committee of Recommendations, and the Council will meet in the Crown Court of the Town Hall-in close proximity, therefore, to the Reception Room.

Badges are prepared for issue to members, which, by resolution of the City Council, will frank members over the Corporation tramways

during the week.

Excursions are rapidly booking up. Those to Gaping Ghyll, the St. Leger at Doncaster, Farnley Hall, and Rievaulx Abbey, and Ampleforth are already over-applied for. When possible, early applicants will receive their excursion tickets through the post before the commencement of the meeting. But in some cases their issue will, of necessity, be delayed until the meeting starts. In these cases the tickets will be awaiting members at the excursion counter in the Reception Room.

The Leeds Art Theatre announces the performance of the "Cradle Song," translated from the Spanish of G. Martini Sierra by John Garret Underhill, which will be given on the evenings of Monday, Tuesday, and Wednesday, Sept. 5-7, at

8.30 P.M.

Citizen's lectures in Leeds have been arranged as follows:

Sir Oliver Lodge. "Energy." In the Albert Hall.

Dr MacGregor Skene. "By-Products of Plant Activity." In the Philosophical Hall. Children's Lectures:

Mr. Kmgdon Ward. "Plant Hunting on the Roof of the World." In the Albert Hall.

Dr. Clarence Tierney. "Nature's Secrets," with

cinematograph illustrations. In the Majestic

Citizen's lectures have also been arranged in Pontefract, Batley, Harrogate, Huddersfield, Otley, Keighley, Wakefield, Shipley, Castleford, Guiseley, and Brighouse.

## Obituary.

SIR BRYAN DONKIN.

BY the death, on July 26, at the ripe age of B eighty-two years, of Sir Horatio Bryan Donkin, the world has lost a sane psychologist and My first meeting with a clear and rational thinker him was in the middle 'eighties, when he was dean of the Westminster Hospital, and I learned to appreciate his sterling qualities when, in my third year, I became his ward clerk. This was during what may be termed the first half of a life spent in the useful service of mankind, for he not long after forsook the practice of physic for a Government official position. As a teacher of medicine Donkin was not only clear and precise in his methods, but also possessed a broad outlook upon the duties of a physician which was in strong contrast with that of some of his colleagues on the hospital staff. To one who was mindful of the limitations imposed by medical tradition, this made work under his guidance a pleasure as well as a duty. It was my privilege in later life to realise still further the value of his friendship. The second part of his life was fully occupied by his duties as H.M. Commissioner of Prisons, duties which he took very seriously Bringing to the post his deep knowledge of medicine and his very kindly nature, he succeeded in introducing more than one salutary reform in prison organisation. He was not one to whom the prisoner was merely a bad lot', he regarded him rather as a patient, and he was, with the late Dr. Mercier, one of the pioneers of the valuable work which has been done in the psychology of crime He was medical adviser to the Prison Commission, and in 1910 delivered the Harveian oration of the Royal College of Physicians upon the subject of the inheritance of mental characters.

A well-deserved knighthood honoured Donkin's retirement at an age when many men prefer to rush out in such quiet enjoyments as, in their consideration, their remaining years permit. He, however, possessed the mind which refuses to become hide-bound with age. He knew how to keep young in mind and body, and he elected to do fighting work for what he considered to be the right. To his straightforward mental outlook and his uncompromising rationalism, everything which savoured of charlatanism and humbug, or was the result of inaccurate and loose thinking was anathema, and he never hesitated to speak and write exactly as he thought. Possessed of a ready pen, his trenchant criticisms upon such subjects as psycho-analysis and various hasty and irrational reforms were characterised by a clearness of argument that made them difficult to controvert. To young writers he was ready of help, and his kındly advice was always acceptable His loss to the cause of rationalism (he was a member of the Rationalist Press Association) is one which will be felt, and his name will be remembered by all with whom the quest of truth is a thing that MACLEOD YEARSLEY. matters.

The issue of the Physikalische Zeitschrift for June 1 contains an account of the life and work of the late Prof. F. Exner of Vienna from the pen of his pupil and colleague Prof. H. Benndorf. Franz Exner was the youngest of the five children of F. Exner, professor of philosophy at Prague, who was called to co-operate with Count Thun in the reform of Austrian education in 1848. He was born in Vienna in 1849 and lost both his parents at an early age. He was a pupil at the gymnasium at Vienna from 1860 until 1867, when he entered the University under Stefan, who although director of the physical institute had no assistants and only a miserable supply of instruments. After two years at Vienna he spent a year under Kundt at Zurich, where his brother was lecturer on Roman law. On his return to Vienna he graduated as doctor in 1871. After acting for two years as assistant to Kundt at Strasbourg, he became lecturer and assistant to von Lang at Vienna and in 1879 professor extraordinary. In 1891, on the death of Loschmidt, he became ordinary professor, and in 1907 Rector of the University. The new physical institute he designed was opened in 1913. He retired at the age limit in 1920 and died in Vienna on Nov. 15, 1926, aged seventy-seven years. During his tenure of the professorship the University of Vienna produced a large number of physicists, who now occupy most of the chairs of physics at Austrian universities and the lectureships at high schools. Of his own researches, those on atmospheric electricity are probably best known; but he also did valuable work on spectroscopy, on colour vision, and on the voltaic cell.

WE regret to announce the following deaths:

Prof. B. B. Boltwood, professor of radio-chemistry at Yale University since 1910, who did noteworthy work on radium and radio-activity, aged fifty-seven

Dr. William Burnside, F.R S., late professor of mathematics at the Royal Naval College, Greenwich,

on Aug. 21, aged seventy-five years.

Prof. E. B. Titchener, Sage professor of psychology in the Graduate School at Cornell, New York, editor for many years of the American Journal of Psychology and American editor of Mind, on Aug. 3, aged sixty years.

## News and Views.

Two esteemed veterans of science—Sir Oliver Lodge and Prof. Henry E. Armstrong-celebrate their golden weddings within a few days of one another, and on behalf of scientific workers everywhere we offer them most cordial congratulations and best wishes for further happy years. Sir Oliver and Lady Lodge were married on Aug. 22, 1877, and Prof and Mrs. Armstrong on Aug. 30, 1877. There is a distinctive quality in the personalities of the wives as well as of the partners of their triumphs and troubles for fifty years. Both Sir Oliver and Prof. Armstrong are distinguished by their originality of thought and independence of action; and both are held in affectionate regard by all who have come under their influence. Their different natures-or rather certain factors which characterise them-are represented to some extent in their eldest sons, Sir Oliver's being a life-long student of art and full of imaginative insight, while Prof. Armstrong's is devoted to industrial chemistry, and is managing director of the British Dyestuffs Corporation, Ltd Heine said that a man should be careful in the choice of his parents, and with the Lodges and Armstrongs the children have had the advantage of both wise nurture and noble nature. Well may they say, in spirit and in truth: "Let us now praise famous men, and our fathers that begat us."

ALTHOUGH young in years, the Institution of Chemical Engineers has so firmly established itself in the professions both of chemistry and of engineering as to make the appearance of a volume of its Transactions an occasion of some significance. The season has passed when a self-styled chemical engineer was merely a chemist who knew how to screw a pipe, or a young engineer who could make himself generally useful, and in particular could manipulate caustic soda with safety. Familiarity with specific industrial plant and works practice is far from being a negligible accomplishment in a chemist, but the qualifications demanded for associate-membership of the Institution go beyond this; they can best be realised by a glance at the examination papers which are reprinted in vol. 4 (1926) of the Transactions, and the examiners' report in connexion therewith. The test, the first public examination in chemical engineering held in Great Britain, was based on the requirement of a thorough general knowledge of chemical reactions and physical laws and a sound grasp of the principles of engineering; it attempted to estimate fundamental knowledge and the mental attitude brought to bear on industrial problems. The Transactions, of which Mr. S. G. M. Ure is the editor, include a report of the fourth annual corporate meeting, with Sir Frederic L. Nathan's presidential address on "Industrial Efficiency", four papers on corrosion, two on statistical methods, and one each on filtration, grinding, the saccharification of wood, alcohol motor fuels, a plant for fat extraction by solvents, a recording torsion dynamometer, refrigeration, and the laws of

air elutriation, together with reports of discussions on each of the papers.

The reader of the Transactions of the Institution of Chemical Engineers is left with a strong impression of the importance of the results both accruing and to be anticipated from the type of investigation fostered by the Institution. The chemical industries, despite, and at the same time because of, their remarkable progress, have accumulated a considerable store of problems concerning which the need for prolonged and systematic research is evident. For example, although the conversion of sawdust into alcohol (with intermediate production of sugar) has long been possible, even on a considerable scale, the process is still unsatisfactory from the point of view of its economics, both in regard to the actual saccharification and to the subsequent fermentation. The present price of petrol, although contributory, is not the only difficulty. The papers on statistical methods are, perhaps, of more than ordinary interest in times when the difference between cost and receipts is so often dangerously small. Works managers in factories other than chemical might well study the scheme of recording which is described. Although they may differ concerning the nature of the information which they require day by day in order to control and maintain production, efficiency, and economy, they may find themselves in substantial agreement as to the best means of obtaining it.

From the Second Circular of the tenth International Congress of Zoology, to be held at Budapest on Sept. 4-9 (incorrectly described in our issue of Aug. 6 as the ninth Congress), we learn that the 146 authors have already announced their intention of reading 162 papers between them. Many of these papers, while doubtless useful additions to knowledge, appear from their titles scarcely to possess that general or fundamental character which might warrant their public reading to a gathering of zoologists from all parts of the civilised world. The subject of general interest that has attracted a large number is tissue-culture, and communications dealing with it are promised by Carrel of New York; Centanni of Modena; Demuth and van Riesen, A. Fischer, Kımura, and Laser of Berlin; Gassul of Kazan; Haan of Groningen, Harrison of New Haven; Krontowsky of Kiev; Küster of Giessen; Levi and Olivo of Turin; Timofejewsky of Tomsk, and Zweibaum of Warsaw. Tissue-culture may perhaps pass, but when one finds several titles like "Zur Physiologie der Tumorzellen" and "Immunity in relation to Implanted Malignant Tumours," or others on white blood corpuscles, one begins to inquire what is meant by 'zoology.' Fortunately the old-fashioned zoologist will find a few papers of broad interest, such as Racovitza "Espèce et lignée," Van Bemmelen "Organismen-Begriff und Zellenlehre," Fedotov "On the Relations between the Classes of Echinoderma," and L. O. Howard "On the International Aspects of Entomology." Or if his tastes are more sporting, he may hear the unweamed Stiles stand up to the irrepressible Poche on the rules of nomenclature.

THE part of the chain of Mont Blanc recently christened "Monte Mussolini" is one of the many peaks comprised in the massif dominated by and generally known as Mont Blanc, but it is wholly in Italian territory. There are at least fifteen high peaks in the chain, from Mont Joli, 2670 metres high, to the Aiguille du Tour, 3542 metres, the highest peak, Mont Blanc, being 4810 metres. Monte Rosa, its Italian sister, rises to 4683 metres, while the highest summit in the Pyrenees, the Nethou, attains only to 3404 metres. The Franco-Italian frontier runs (in theory) along the summits of the high peaks of Mont Blanc, but in one place the Italian line lies on the wrong side. It happened that when Savoy was ceded to France, in 1860, Victor Emanuel expressly reserved a little enclave on the other side, as that spot was the haunt of the chamois he so dearly loved to hunt. It was in a somewhat similar way that the ex-Emperor of Germany, when the frontier was delineated between British, and German East Africa, persuaded the British Government to deflect the otherwise straight line so as to include Kilimanjaro, as he wished Germany to possess the highest mountain in Africa.

An account of the work of the Discovery Expedition up till Aug. 18, 1926, has already appeared in these pages (NATURE, Oct. 20, 1926, p. 628). In the recently published first annual Report of the expedition (London: H.M. Stationery Office. 1s. 6d. net) an outline of the work carried out for the remainder of that year is given. The R.R S. Discovery, together with the additional Research Steam Ship William Scoresby, which arrived at Cape Town on Aug. 1. embarked on the programme originally arranged. Leaving Simon's Town on Sept. 21, the Discovery proceeded on two short cruises off the African coast for work off the Saldanha Bay whaling grounds. On Oct. 27 she left Africa for South Georgia, arriving there on Dec. 5, after having to change the route originally chosen-south from the Cape to about Lat. 58°—owing to exceptional ice conditions. Meanwhile the William Scoresby had been employed in whale marking and taking plankton collections off the African coast until Oct. 21, after which she sailed for South Georgia. Arriving before the Discovery, on Nov. 8, a line of plankton stations was run by her along the north-west coast, and whale hunting was undertaken for marking purposes. Afterwards the two ships combined in a plankton survey of the whaling grounds. Observations were resumed by the staff of the Marine Station at Grytviken, in South Georgia, early in November. Amongst other valuable data obtained by them during their previous stay at Saldanha Bay was an embryo of a Sei whale, only 2-3 mm. long, believed to be the youngest embryo which has ever been found in a whale. The Discovery left Simon's Town for Portsmouth on July 18 via the west coast of Africa and is expected to arrive in October. Before

further sea work is undertaken, the scientific staff will spend two or three months working up the results of their collections, which are housed in the Natural History Museum.

THE reports of the electrical engineers of the Brighton and Bradford Corporations who have independently visited the United States to inspect American power stations and transmission lines are of interest. Abstracts of them have been published recently in various technical journals. In their opinion, the Americans are in advance of Great Britain in boiler-house practice. The use of pulverused fuel is becoming common. In New York the Steam Corporation supplies its consumers directly with 5000 million pounds of steam every year for heating purposes. The high-pressure steam pipes, covered with heat-resisting material and provided with valves and expansion joints, have been admirably designed. If we except the large size of the steam turbines, there was little in the power stations themselves that was found to be novel. Many of the new capital stations have very much higher load factors than any in Great Britain, being loaded in some cases up to 80 per cent. of their maximum capacity. The price of electricity, however, is not cheap. In the opinion of these British engineers the overhead transmission lines, worked at very high pressures which convey large supplies of power from one station to another, instead of marring the beauty of the landscape, give an added interest to it. In Chicago the Commonwealth Edison Company has constructed a very large new generating station. There is an underground ring main which will be operated at 132,000 volts and will inter-connect all the power plants and substations of the company. This is a new departure, and its operation will be studied with great interest by electricians. The sign lighting in Broadway and Times Square, New York, is marvellous, and greatly improves the somewhat meagre direct lighting from street lamps. Some of the smaller cities and towns visited had better street lighting than New York. We agree with the statement that it would be a great boon to all road users in Brighton if the candle power of all the street lamps was doubled.

THE rapid improvement which is taking place in the thermal efficiency of electric generating stations is very satisfactory, as it shows that old-fashioned apparatus is being scrapped. In the July number of World Power, H. Quigley gives statistics which indicate some of the economies which have been effected by this increased efficiency. During the last five years the average fuel consumption per electric unit generated in British generating stations has diminished from 3.11 lb. to 2.40 lb. If this diminution had not taken place, about two and a half million tons of coal in addition would have been consumed. The average of 2.4 lb. per unit is not much greater than the average of 2.1 lb. per unit obtained in America. The author, taking the average of the twenty-five largest and most efficient stations in Great Britain, finds that since 1922 the average consumption per unit generated has fallen from 2 05 lb. to 1.80 lb. Twenty-five per cent. of the national output of electricity is generated by these stations. The Barton station at Manchester achieved in 1925-26 the record efficiency, generating a unit for every 1 36 lb. of coal consumed. Practically all the modern generating plant in these stations has been manufactured by British firms. Provided that trade is prosperous, so that the load factor of the generating stations continues to increase, there is every prospect of much better results being attained in the immediate future. The new Government schemes will help in this direction

The first issue has appeared of the Journal of the Ministry of Agriculture for Northern Ireland (Belfast H.M. Stationery Office, price 2s. 6d), its object being to provide a medium for the publication of the results obtained by the different agricultural research divisions of Northern Ireland. The articles are intended to be in a form which should render them easily understood by the farmer, while in no way affecting their scientific value. One of the chief problems is to discover a phosphatic fertiliser which will be suitable to the crops and soils of the district, and also an efficient substitute for the high grade basic slag now rapidly disappearing from the market. Experiments are recorded which show that North African rock phosphates can be successfully used, with the further advantage of reduction in cost Investigations in connexion with the loss of vigour in stocks of potatoes are of special importance in view of the efforts being made to develop a seed potato trade in Northern Ireland. Deterioration is much more rapid in early than late districts, thus enabling the latter to provide healthy stocks for the former when change of seed is needed. The practice of cutting potatoes is quite successful on light, dry soils, provided it is done at the time of planting. With regard to plant diseases. American gooseberry mildew is one of the most serious problems confronting the fruit growers in Ireland, but it can be successfully controlled by suitable spray mixtures. Silage investigations are of particular importance owing to the prominent part played by live stock in the farming of this district. The yield from a mixture of oats, beans, vetches, and peas, though less than the average yield of turnips, is more certain, and further, the crop has a considerably higher dry matter and feeding value than roots. In addition to the main articles. bibliographical reviews and short notices of recent important agricultural publications are appended, which should prove of the greatest value to both farmer and agricultural instructor.

In 1928, on Sept. 24-Oct 6, it is proposed to hold a Fuel Conference at the Imperial Institute, London. This will be a sectional meeting under the auspices of the International Council for the Organisation of World Power Conferences—the first of which was held at Wembley in 1924. Lord Balfour has accepted the honorary presidentship, and Sir Alfred Mond the presidentship, while the chief participating industries,

including coal, oil, gas, and chemicals, are strongly represented in the organising committees technical programme covers solid, liquid, and gaseous fuels, utilisation of fuel, and the general aspects of the fuel question, including training. The programme will include questions of composition and classification of fuel, preparation, storage, handling, and transmission. Evidently the scope of the conference is extremely wide. To shorten proceedings, it is proposed to accept normally only authoritative reports from representative bodies of the participating countries. A preliminary announcement has been issued from the central office, 36 Kingsway, London. W C 2. The secretariat consists of Messrs. Sholto S. Ogilvie and M W Burt (general secretaries) and Dr E. W. Smith and E. J. Fottrell (joint technical secretailes)

The chief interest of the annual report for 1925 -1926 of Bergens Museum (Bergens Museum Aaresberetning, 1925-1926) drawn up by the Director, Prof. Carl Frederic Kolderup, lies in the large amount of original research forthcoming from all departments, which shows a very flourishing state of aftairs. Amongst the many well-known and valuable publications of the Museum is included Vol. 9, parts 11 and 12, of the late G. O. Sars's "An Account of the Crustacea of Norway," continuing the Ostracoda. Attached to the Museum is the Biological Station at Herdla, and here many visitors have availed themselves of the opportunities offered to workers, where the Director, Prof. Aug. Brinkmann, and his assistants are themselves engaged in investigating marine problems. At the Geophysics Institute hydrographical work under the direction of Prof. Helland-Hansen is being carried out, observations being undertaken on temperature, salinity, and carbon dioxide content of the fjords round Bergen, with direct registry of the density of the upper water layers by means of the 'pycnosonde,' an apparatus recently constructed by Dr. D. la Cour, Director of the Danish Meteorological Institute.

Although historically unimportant, Tut-ankhamon will no doubt long continue to occupy a prominent place in popular regard and an added interest be taken in any historical details concerning him or his entourage which can be brought to light. Prof. Forrer has now published in full a corrected and amended copy of the Hittite cuneiform texts relating to the negotiations between Tut-ankh-amon's widow and the Hittite king Subbiluliumas for her remarriage, which has been translated by Prof. Sayce in Ancient Egypt for June. While the king was at Carchemish, the queen sent him an envoy asking for one of his sons in marriage as "My husband is dead and I have no son." With characteristic caution the king sent the Chief Secretary, his High Chamberlain, to Egypt "to bring back an accurate report as to whether she is in any way deceiving me and what has become of the son of their (late) master," a proceeding which seems to have aroused the queen to some indignation, which she expresses in a subsequent despatch. This text raises an interesting question as to the method of making and filing these official records. Apparently there were two copies, one on clay and one on bronze, one of which was a draft, though which is not quite clear. Sir Flinders Petrie adds a figure of the Princess from the tomb of Panehesy at Tell el Amarna

THE need for scientific research in the fishing industries is concisely stated by Maurice Holland in a short paper which has been issued by the U.S National Research Council (No. 74, Reprint and Circular Series of the National Research Council, Dec. 1926). His remarks indicate the indifference with which the fisheries have, in the past, supported a rational research programme. Whilst dealing only with the specific problems presented by the United States, his remarks are generally applicable Fisheries products, in spite of their importance, make up no more than 3 per cent. of the world's food supply, this only represents 40 per cent. of the total catch, and the remainder gives but a small return. The author gives a summary of future commercial possibilities in which the 60 per cent. by-products might be profitably utilised. A comparison is made with other industries, particularly with the meat-packing industry; it appears that out of 115 industries, less than ten have a higher number of wage earners. though the value of the annual product per person is very low. It is suggested that the formation of a fisheries bureau similar in scope to the Conseil Permanent International of Atlantic countries, but dealing particularly with the Pacific countries, would be of great help in future developments.

Under the title of "Flottierende Stationen," Dr. H. C. Redeke, in "Abderhalden's Handbuch der biologischen Arbeitsmethoden" (Abt. 9, Teil 2/2, pp. 1249-1257, 1927), gives particulars of a houseboat used for inland fishery research on the Dutch waterways. This well-equipped laboratory, built on a barge 81 ft. × 19 ft., is illustrated by a photograph, where it is seen moored in a placid Dutch waterway—an ideal laboratory and summer residence which can be towed from place to place at small expense as occasion demands. The relative advantages of wood over iron construction, equipment, and accommodation are discussed. Three other floating biological laboratories exist, on Lough Derg, in Illinois, and in Quebec.

In a note entitled "Non-Marine Mollusca of the Belgian Congo" in our issue of Aug 6, p. 204, reference was made to the lack of an index to the collections. A correspondent informs us that, in answer to an inquiry, the Librarian of the American Museum of Natural History stated that an index to "The Aquatic Mullusks . . ." will be ready very shortly.

THE April issue of the Proceedings of the Imperial Academy of Japan contains a list of the grants to be made out of the research funds of the Academy for the fiscal year 1927-28. Of the seventy-one grants made, eighteen are for religious, historical, literary,

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and economic studies, and fifty-three for scientific and medical work. In the latter group may be mentioned investigations on asteroids, earthquakes, Japanese coal and petroleum, air movements, synthesis of paraffins, soil and its organisms, crops, genetics of insects, nutriments, effects of poisons on the nervous system, metabolism, and cancer. Further grants recommended by the Academy were made out of the Toshogu Memorial Fund by the Board of Directors of that Fund

The British Museum (Natural History) has recently issued a "Guide to the Crustacea," by Dr. W. T. Calman, which forms an excellent handbook to the study of the specimens of the class Crustacea exhibited in the galleries of the Museum. Brief accounts are added of the Trilobita and the Pycnogonida. The guide is well illustrated by fifty-three drawings and photographs.

A CATALOGUE (No. 499) of second-hand books—some 341 in number—on British and foreign birds has just been issued by Mr F Edwards, 83A High Street, Marylebone, W 1. It can be had from the bookseller upon application.

A CATALOGUE (No. 1, New Series) of second-hand books, pamphlets, and serials relating to natural history has reached us from Mr. A. J. Bateman, "Tintern," Hampden Park, Eastbourne. Some 850 works are listed. The prices asked appear to be reasonable.

MESSRS. W. Heffer and Sons, Ltd., 4 Petty Cury, Cambridge, announce for early publication a new book by Dr H Martin Leake, entitled "Land Tenure and Agricultural Production in the Tropics," being a discussion on the influence of the land policy on development in tropical countries.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned .-- A lecturer in physics and electrical engineering at the Leigh Municipal College—The Director of Education, Town Hall, Leigh, Lancs. (Sept. 3). An assistant in the Records Bureau of the Department of Scientific and Industrial Research—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Sept. 12). A specialist in medical entomology in the Ankylostoma and Bılharsia Research Section of the Public Health Laboratories of the Egyptian Government—The Under-Secretary of State, Department of Public Health, Cairo, Egypt (Sept. 15particulars from the Egyptian Legation, 75 South Audley Street, W.1). An assistant bacteriologist in the East African Medical Service-The Private Secretary (Appointments), Colonial Office (38 Old Queen Street, S.W 1 (Sept. 17). A lecturer in engineering at the Cape Technical College, Cape Town-Chalmers and Guthrie, Ltd., 9 Idol Lane, E.C.3 (Sept. 19). An assistant lecturer in electrical engineering at the Manchester Municipal College of

Technology—The Registrar, Municipal College of Technology, Manchester (Sept. 19). A demonstrator in agricultural botany in the University of Reading—The Registrar, The University, Reading (Sept 24). A senior lecturer in physiology in the University of the Witwatersrand, Johannesburg—The Secretary. Office of the High Commissioner for the Union of South Africa, Trafalgar Square. W C.2 (Sept. 26). Research appointments, as follow, under the Ministry of Agriculture, Cairo, Egypt—a chief entomologist, an entomologist for entomologisal research, a mycologist, and another entomologist, each in the Plant Protection Section; two botanists in the Botanical Section; and a chief chemist, a soil physicist, and a soil bacteriologist in the Chemical Section—The

Under-Secretary of State, Ministry of Agriculture, Cairo, Egypt (Oct. 1). A director of tobacco investigations under the Commonwealth Government and the States of Australia—The Official Secretary, Commonwealth of Australia, Australia House, Strand, W.C.2 (Oct. 17). A physics specialist at the Liverpool Collegiate School—The Director of Education, 14 Sir Thomas Street, Liverpool. A lecturer in estate management (including farm machinery) at the Harper Adams Agricultural College—The Principal, Harper Adams Agricultural College, Newport, Shropshire. A chemical laboratory assistant in the experimental department of the Fine Cotton Spinners' and Doublers' Association, Ltd.—The Chief of the Department, Rock Bank, Bollington, Macclesfield.

#### Our Astronomical Column.

NAKED-EYE SUNSPOT —A recent spot of considerable size is the eighth to be observed this year as a naked-eye object on the sun's disc. The growth of the spot was rapid, and it originated in a place immediately in front of the disappearing fragments of a group which was near the east limb on Aug 9. The following table shows the rate of growth, the area being measured in the customary units of millionths of the sun's hemisphere:

 Date
 . . Aug. 12
 Aug 13
 Aug 14
 Aug 15
 Aug 16
 Aug 17

 Area
 . . . 25
 160
 550
 900
 1150
 1300

 Lone from central meridian
 25°E
 12°E
 2°W
 15°W
 28°W
 41°W

On Aug. 16 the spot was approximately 40,000 miles in length and 30,000 miles broad. Its structure was complex with several umbræ. In appearance it resembled those spots the magnetic polarities of which are found to be irregular and are, according to the Mt. Wilson observers, most likely to be associated with terrestrial magnetic disturbances. In the present instance no disturbance has been reported, but as the spot, when near the central meridian, had not reached its maximum growth, it will be of interest to await its second transit about Scpt. 10. The duration of large irregular spots is not proportionate to their size, a smaller spot of regular outline often lasting much longer, but the return of the recent spot may well be expected on Sept. 4 at position angle 122° from the north point on the sun's east limb. Other details of the spot are as follows:

No. Date on Disc Central Meridian Latitude. Max Area

8 Aug. 11-20 Aug 14-2 10° S 1/750 of hemisphere.

The Temperature of Mars.—Prof. H N. Russell gives in The Scientific American for July a simple description of the work of Drs. Coblentz and Lampland on the heat received from Mars (see also Nature, Sept. 19, 1925, p. 439). They used a very delicate thermocouple, and screens of glass, quartz, fluorspar, or cells containing water to isolate different wave-lengths of the heat spectrum. The chief difficulties were the effects of the atmospheres of the two planets, that of the terrestrial atmosphere was minimised by the high altitude and dry climate of Flagstaff. It is noted that a moist, slightly hazy atmosphere tends to increase the surface temperature of a planet since it retards the escape of radiation of long wave-length: but for this very reason observations made from another planet are

likely to give too low a value for the surface temperature, since they are derived largely from reflection from the upper surface of the haze. It is thus explained why the temperature at the melting edge of the polar cap was measured as  $-75^{\circ}$  F. in 1924, when it must have been in the neighbourhood of  $30^{\circ}$  F.

Taking the necessary corrections into consideration, Dr Coblentz gives the following estimates of the noon temperatures of different zones of Mars in the late summer of the southern hemisphere:

Zone,		Temperature (F)				
South polar region				$15^{\circ}$	to	50°
South temperate zone				65	,,	75
Tropics				65	,,	85
North temperate zone				30	,,	60
North polar region (sou	ather	n part)		- 40	•••	+10

The nights are probably very cold, even at the equator.

The above values are stated to be in good agreement with those found by Messrs. Pettit and Nicholson at Mt. Wilson in 1924. For example, they gave the noon temperature in the tropics as 80°, after correcting for the effects of cloud and haze.

The temperatures as a whole are much higher than was previously thought probable, and this is obviously a point in favour of the planet's habitability.

The Mass of Venus.—The issue for June of Mon. Not. R.A.S. contains two papers on this subject Dr. H. Spencer Jones rediscusses the observations of Mars made with the Cape heliometer at each opposition from 1899 to 1924, applying some necessary corrections to a former discussion. His new value for the mass of Venus in terms of the sun is 1/411.300, with a probable error of 1 part in 300. This is 1 per cent. smaller than Newcomb's mass and 3 per cent. smaller than Le Verrier's.

The other paper, by Dr. J. K. Fotheringham, deals with all determinations of the mass of Venus from 1750 to the present time, and shows that they may be divided into three groups. The observations from 1750 to 1846 give a small mass, those from 1846 to 1888 a large one, the remainder an intermediate value, nearer the first than the second. Dr. Fotheringham regards the change in the mass as real, but most people will consider this as improbable as that the length of the seconds pendulum should change by an inch or so. It is, however, very useful to have all this material rediscussed, though the apparent change remains a puzzle.

## Research Items.

AINU NEOLITHIC IMPLEMENTS.—We have received a communication from Dr. N. Gordon Munro of Karunzawa, Japan, in reference to our comments on the Rev. F. Smith's book, "Prehistoric Man and the Cambridge Gravels" (see Nature, April 9, p. 523), and directing attention to the question of the derivation of certain types of paleolithic implements from shell forms Dr. Munro states that among his collection of Amu neolithic implements, now unfortunately de-troyed by the earthquake, were a considerable number commonly called Tengu no meshi kan, or ricespoons of the Tengu, Tengu possibly meaning spirits of the wild or soil. Inspection suggested that these were copies of shells, and as they were made of igneous rock, obsidian, or chert, rarely agate, there could be no question of the conchoidal fracture being responsible for the form. Conventionalism had resulted in a notched or button-shaped survival of the umbo, but of the attempted representation of the convexity and concavity of the shell there could be no doubt. Kai stands for both spoon and shell, and in the ancient Chinese pictographs the spoon is represented by a shell, and shells are still in use in Japan as spoons. This may be in part responsible for the survival of the name quoted. Dr. Munro has exammed a large number of specimens from the Thames gravels, and among them has recognised many as sımılar to his Ainu specimens,—a resemblance based upon the ensemble rather than the conchoidal fracture. He suggests that the palæolithic artisan noted the resemblance and was influenced thereby to transfer the functional form of the shell to the fimt.

Consanguineous Marriage in Ancient Egypt. —In Ancient Egypt for June, Miss M. A Murray examines a number of genealogies recorded on stela of the Middle Kingdom with the view of extracting the relationships of those who are mentioned as married or whose marriage can be inferred Consangumeous marriages occur, though infrequently; but occasionally the names suggest that the custom had been more general. Such a name, for example, as "My mother is my sister" indicates a father-daughter marriage and "My father is my brother" a mother-son union. Particularity of definition is such in some cases as to preclude the argument against these types of marriage that terms of relationship were then used more loosely and must not be construed literally. It is to be noted that these marriages occur in all classes of society, and there are those of small officials not necessarily connected with the royal house or the families of great nobles. It is, no doubt, also significant that these marriages are usually found in families where the name Wah-ka, Bebu, or Beby, and names compounded with Khnum and Sebek are used. In the genealogy of Wah-ka is a father-daughter marriage, his grandfather having married his two daughters, one of whom was Wah-ka's mother. Another father-daughter marriage and an aunt-nephew marriage is shown in the stele of Horzeruy. A mother-son union is probable in the case of Nefer-rud, whose mother and wife Hetept were possibly one and the same. The genealogy of Sen-mry Kheper-ka-ra can be explained only as the marriage of one man with three women, two of whom were his own daughters. Mother-son marriages occur also on the stelæ of Sebek-dedu, the scribe of the stone-masons, Pa-unt, and the goldsmith, Sebek-hetep. The marriage of Se-hetep-ib shows the union of brother and sister, while an aunt-nephew union of the kind familiar from the parentage of Moses occurs in the genealogy of Ptah-sankh-en.

Puja —In the Indian Antiquary for May and July is a study in two instalments of certain elements in Hinduism by Prof Jarl Charpentier of Upsala. The religion of the Aryans, as set forth in the Rig-Veda, was the religion of the upper classes, it was too complicated and its ritual too expensive for the masses All its gods were males and there were no temples and no images. Among the aboriginal subject races the religion of the Munda-speaking tribes was a crude form of animism including human sacrifice to an earth goddess; while the Dravidian religion included the worship of she-devils and the spirits of the dead, the female element was predominant and crude idols were put up either in the open air or under the shelter of small temples. Sacrifices were characterised by the use of blood which was smeared on the idol or the worshippers and was used when poured on cooked rice as a common meal These forms of religion were totally opposed to that of the Arvans, which, however, at an early date compromised by incorporating godlings and taking in idols and temples. These gods and godlings are now adored by a number of ceremonies comprised under the name puja, which takes a central place in the daily routine followed in Hindu temples, in which the god is treated as a living monarch routine the characteristic element is the washing of the idol or the sprinkling of the linga with water or with honey, curds, honeyed water, etc., or the sinearing of it with certain ointments, powders, or oily substances which are generally of a brilliant red or yellow colour. Of the various derivations, few in number, offered for the term puja, the most likely seems the Dravidian root pûçu, Kanarese pûsu, meaning to sinear, put on sticky substances, to daub, to paint. Now in all the more primitive cults of India the most common way of adoring the various gods is to smear the wooden logs, uncarved stones or idols representing them with oil or lac, cinnabar, turmeric, or other red or yellow dyestuffs; and this practice is even extended to the tools of certain castes at various seasons, eg, the Rajput guns, the Thug pick-axe, the agricultural implements of the Decean. The rite thus has its origin in very primitive conditions as it is practised among low-caste peoples, and in advanced Hinduism it is now most frequent in the case of such gods as Ganesa and Hanuman who are of low origin.

The Feeding Mechanism of Nebalia.—Prof. H. G. Cannon (Trans. R. Soc. Edin., 55, No. 15, 1927) describes the feeding mechanism of Nebalia bipes—a mud-dwelling form which feeds on particles filtered from a food stream produced by its foliaceous trunk limbs. The food stream enters at the anterior end and makes its exit at the posterior end of the carapace. The current is produced by the oscillatory movements of the trunk limbs, and a detailed account is given of the movements and of the setal armature of these appendages. The mouth parts, structurally and in their method of functioning, closely resemble those of a mysid. From a comparison with Paranebalia it is suggested that Nebalia evolved from a mysid, or from some other primitive malacostracan possessing a feeding mechanism similar to that of Hemimysis, that took to living in mud. The foliaceous limbs are in no way primitive, but have evolved from typical biramous malacostracan limbs in connexion with the new method of filter feeding.

EEL LARVE.—In a recent issue (vol. 2, No. 1, p. 38) of the Journal du Conseil Permanent Inter-

national pour l'Exploration de la Mer, Prof. Johs. Schmidt supplies a new record of the capture of the larvæ of the common eel in the Faroe-Shetland Channel Previous to 1926, only four specimens of metamorphosing eel larvæ not vet at the elver stage had been taken east of Long. 5° W., but on Aug. 11, 1926, the Dana, under the supervision of Å. V. Taning, made a capture of 297 larvæ in the southern part of the Faroe-Shetland Channel—60° 35′ N., 3° 45′ W.—over soundings of 366 and 470 metres. The great majority were in the metamorphosis Stages II and III, although 9 per cent were in Stage I and had not commenced metamorphosis Most of the larvæ were found at a depth of 20-30 metres below the surface. The average lengths for the various stages in the retrograde metamorphosis were, Stage III, 75 46 mm., Stage II, 74 33 mm., and Stage IV (of which there were only 11 specimens), 72 46 mm.

GRASSES OF THE CENTRAL ANDES -The Smithsonian Institution has just issued a work on the grasses of the Central Andes—Ecuador, Peru, and Bolivia, by that eminent agrostologist, Dr A S Hitchcock (Con. U.S. Nat. Herb., vol. 24, part 8). Most of the region is mountainous, and although lying under the equator, many ranges and peaks are capped with snow. The flora is mainly temperate and alpine, but becomes tropical on the coastal plain and on the eastern slope There are wide variations in rainfall over the region, and because of the extremes of altitude and precipitation the giass flora is large and varied. While the very detailed information in the book has been collated from many herbaria, and every available source of information has been laid under contribution, the list of grasses is based primarily upon the specimens in the United States National Herbarum. The descriptive lists and keys include 124 genera and 605 species, of which 29 species are new.

GROWTH OF POLLEN TUBES -P. O'Conner, experimenting on the growth of pollen grains, finds that malic acid has no directive influence on the growth of pollen tubes of Angiosperms (Scientific Proceedings, Royal Dublin Society, vol. 18 (N.S.). No. 40, July 1927) By adding watery extract of stigmas to a medium consisting of gelatine and cane sugar, he was able to inhibit growth of all pollen except that of species from which extract was made. medium containing extract of tulip stigmas which had been inseminated with a mixture of crocus, daffodil, and wallflower pollen, permitted the development of the tulip pollen tubes only. As the hydrogen ion concentrations of the various stigma extracts were of much the same order, he rules out the possibility of acidity as a determining factor. Osmotic concentration is similarly eliminated. The inhibiting substances are diffusible through permeable membranes and are not destroyed by boiling, which tends rather to accentuate their inhibitory effects, probably through a reduction of oxygen tension Where growth of pollen tubes did occur in an inhibiting medium, the tubes produced were frequently of a monstrous type On "general biological considerations" the inhibiting substances are supposed to be of an amino compound nature. Extracts from other parts of the plant were found equally inhibitive of the growth of foreign pollen grains, and the author suggests a specificity of the sap, and considers that possibly the 'sap' may be the source of mutation, and the protoplasm largely its instrument.

SIZE OF THE GENE.—The conceptions connected with dominant and recessive genes are closely analysed by Dr. A. S. Serebrovsky (*Jour. Genetics*, vol. 18,

No. 2) in a paper on the influence of the 'purple' gene on crossing over in the middle part of chromosome II. in Drosophila. The experiments were carried out in a thermostat owing to the well-known effect of temperature on crossing-over, and 120,000 flies were bred and examined in three months. Since the age of the female also affects the crossing-over, the eggs laid during the first and second six-day periods of life were kept separate. The records of females which hatch on successive days were also kept separate, as the later emerging flies become progressively smaller until the last are dwarfs. Flies which hatched late showed diminished crossing-over, although this was not very regular. A new method is worked out for determining the approximate size of the 'purple' gene from the data of crossing-over. It is suggested that genes may vary in size, and that the presence absence theory may be revived if divisibility of the genes is admitted. There is a certain periodicity in the occurrence of cross-overs, but the coefficient of variation in their frequency is of the same order as other biological co-efficients of variation.

CARBON RATIO THEORY —In the Journal of the Institute of Petroleum Technologists for April, Dr. Murray Stuart raises a significant point in connexion with the real interpretation of the carbon-ratio theory As is generally known, David White first observed the relationship between the carbon-ratio of coals and the likelihood of oil occurrence in associated strata in America, since which time the theory has been applied to similar occurrences in many parts of the world, perhaps with indifferent success. However, it is now pointed out that what has hitherto been loosely referred to as the carbon ratio, i.e. ratio of C to H, is really not a ratio at all, since what is meant is the percentage of fixed carbon (pure coal basis) in the coal. The analysis of coal is usually expressed in terms of moisture, fixed carbon, volatile matter. and ash; neglecting moisture and ash, it is the relationship between fixed carbon and volatile matter which constitutes the so-called carbon ratio. "As the percentage ratio is taken as the basis of the carbon-ratio theory, it is not necessary to express the ratio as a ratio, . . . (but as) the percentage of fixed carbon in the sum total of the fixed carbon plus volatile matter of coal." Thus if the carbon ratio is quoted as 55, then the ratio of fixed carbon to volatile matter in the coal is 45 To some extent the mistake has arisen in thinking that all the carbon in coal exists in the fixed carbon portion and that the volatile matter is exclusively hydrogen, in which case the C'H ratio is a reasonable interpretation; but, as Dr. Murray Stuart points out, there is a considerable quantity of carbon in the volatile matter of a coal, and coals are known where the carbon ratio is 50, but where the percentage ratio of carbon to hydrogen is more than 90, in the same examples.

Cat Creek and Devil's Basin Oilfields, Montana.—In a somewhat unusually stereotyped bulletin (No. 786B) of the United States Geological Survey, Mr. Frank Reeves gives an account of two recently discovered oilfields in Montana. The area falls within the Great Plains province, though it possesses a diversified topography, much of which is formed by the Lance formation (? Eocene). The principal structural feature is that of the Cat Creek-Devil's Basin uplift, a rectangular area of some 2000 square miles, characterised by numerous and pronounced domes along the margins. Of the two oilfields in the region, that of Cat Creek is commercially the more important, having a daily production of about 2800 barrels (1926) from 190 wells. Four distinct sands have been recognised in the field, the

Mosby, First, Second, and Third sands, most of the oil being derived from the First and Second horizons, especially the former, the stratigraphical horizon of which is the base of the Colorado Shale, bottom of the Upper Cretaceous. Mr. Reeves believes that the source of the oil is the Colorado Shale, which, besides having the colour suggestive of abundant organic matter, has been proved by testing to contain free oil and pyrobitumens; this formation is, incidentally, the most prolific oil-producing horizon in the Rocky Mountain region. The Cat Creek oil is of mixed base, with a gravity varying from 47° to 50° Baumé and containing little sulphur; thus it is a remarkably light oil, some 6° lighter than the average Appalachian The author does not believe that such oil is due to natural fractionation of heavy oil through porous strata of the fuller's earth type, as suggested in some quarters, but attributes its high quality to normal conditions, pointing out that only a slight modification of much of the Cretaceous oil of this region is necessary to produce a crude of the type met with at Cat Creek.

THE SPECTRA OF ZIRCONIUM AND SCANDIUM.-Papers 548 and 549 of the United States Bureau of Standards are devoted to wave-length measurements in the arc and spark spectra of zirconium, and in the arc spectrum of scandium, by C. C Kiess and W. F. The scandium ammonium Meggers respectively. oxalate which was used was originally prepared and purified by Auer von Welsbach, and had at one time formed part of Prof. Eder's collection. The zirconium metal, although of high chemical purity, showed considerable spectroscopic contamination, and amongst the foreign lines there were a number due to the recently discovered element hafnium. 700 scandium lines are listed between 2500 Å.U. and 8600 Å.U., and about 1500 zirconium lines between 2100 Å.U. and 9300 Å.U. Both arc spectra are superposed on a system of bands. The latter have not been analysed, but it is stated that a very satisfactory analysis of the line spectra of scandium has been effected, which will be published shortly.

ELECTROMETER CAPACITANCES.—In the issue of the Physikalische Zeitschrift for June 15, Dr. H. Witte gives an account of his measurements of the capacitances of a number of electrometers and their variation with the deflexion of the instrument The work was undertaken at the suggestion of Prof. Ludewig and was supported by a grant from the Helmholtz Asso-Two radio valve circuits of frequency 105 were magnetically coupled by a circuit containing a telephone to a third similar valve circuit. Two of the valve circuits contained small adjustable capacitances. and the method of measurement consisted in inserting the electrometer in one valve circuit and either counting the number of beats heard in the telephone or in adjusting one of the capacitances until the beats ceased. For a single filament electrometer with attracting plates, the positions of the plates made a change of 4 per cent. in the capacitance, which was of the order 1.5 cm. For a Wulf single filament electrometer without attracting plates, the deflexion of the filament altered the capacitance of 2·1 cm. by about 2 per cent. For a gold-leaf electroscope of the Elster and Geitel type, the capacitance, 8 cm., varied 6 per cent. with the deflexion.

LIMITING VOLUMES AND CRITICAL ISOTHERMALS OF LIQUIDS.—Although in most of the equations of state hitherto proposed the limiting volume of a liquid at infinitely high pressure,  $v_{\infty}$ , has been assumed constant and equal to the limiting volume at the absolute zero of temperature,  $v_0$ , this assumption does not seem to have any theoretical basis. The *Proceedings of the* 

Physico-Mathematical Society of Japan for Feb. 1927 contain a paper by Y. Tasiro in which values for  $v_{\infty}$  for some organic liquids have been extrapolated from Bridgman's well-known data. The calculated values of  $v_{\infty}$  tend to increase as temperature decreases, but since the method of extrapolation is of doubtful accuracy, it is not safe to draw any positive conclusions as to the constancy of  $v_{\infty}$ . On comparison with the corresponding calculated values of  $v_0$ , however, it is quite clear that the two quantities are not equal,  $v_{\infty}$  being much smaller than  $v_0$ . From the values of  $v_{\infty}$ , the constant b of the Van de Waals equation has been obtained, and the values of  $v_{\infty}$ ,  $v_0$ , and b have been applied to the calculation of the pressure-volume relationship of isopentane, using a modified equation of state. The calculations agree with the observed values of Young even up to high pressures.

DIESEL-ELECTRIC LOCOMOTIVES —Experiments are being carried out by railway engineers in America and in several European countries on the use of Diesel engines in connexion with traction. In the Brown Boven Review for July, details are given of a Diesel-electric locomotive of 400 horse-power which has been built for the Strade Ferrate del Mediterraneo (Italy). This railway has about 600 miles of track in the provinces of Basilicata and Calabria, on which there are several long 6 per cent. inclines ments are also being made at the same time on special steam locomotives. It is specified that the locomotives must be able to draw a train weighing 110 tons up a 6 per cent. incline at a speed of 27 miles per hour. The engine of the Diesel locomotive is rated at 440 brake horse-power, but it can develop 500 B.H.P for short periods. The electric generator, which drives four ordinary traction motors mounted on the axles of the locomotive and two of the same type on the trailer, is directly connected to the Diesel engine by a rigid coupling, a special electrical system being used to minimise losses during the starting and stopping of the train. Experiments carried out on this locomotive by the Swiss manufacturers show that the mean consumption of naphtha per ton mile trailing load was about 0 068 pound. With steam service the fuel cost was practically twice as much. In the earlier experiments vibrations were pronounced owing to sudden variations in the load and owing to the machines being out of balance. The special balancing device now employed has notably diminished these vibrations. In special cases where no suitable electric supply is available these locomotives should prove useful.

REDUCTION OF MIXED OXIDES.—It has been stated (H. G. Wells, "The Outline of History") that "bronze is not only harder than copper, but the mixture of tin and copper is more fusible and easier to reduce." Thus it would appear that an oxide is Thus it would appear that an oxide is actually reduced at a lower temperature when in presence of a second metallic oxide. This subject has been investigated by W. Rogers, using a mixture of zinc and copper oxides. The mixtures were heated electrically to 300° in a glass tube through which a current of dry hydrogen was passing. The water formed in the reduction was collected in weighed tubes of calcium chloride. The data has been published in the Journal of the American Chemical Society for June, and it is obvious that all the zinc oxide in. the mixtures has been reduced. It is suggested that on fusing the oxides together, the presence of the second oxide prevents the units in the lattice structure of the other from arranging themselves in the normal way. This would cause the forces between the units in the structure to be altered and would result in a change in the reactivity of the oxides towards hydrogen.

## Pelagic Nemerteans.1

THE power of progressing through the water by swimming has long been known in the nemerteans; thus Nardo mentions it in Cerebratulus marquatus. Grube in Meckelia aurantiaca. De Quatrefages in Polia bembix, whilst more recently it has been described in Amphiporus pulcher, O.F.M., A. (Drephanophorus) spectabilis, De Quatref., Micrura fusca. McI., and Tetrastemma dorsalis. Abild. But the first truly pelagic nemertean was only brought into notice by Prof. Moseley during the voyage of the Challenger (1875). Now, through the labours of Hubrecht, Verrill, Craven and Heath, Brinkmann. Joubin, Gerarda Stiasny-Wijnhoff, and others, a long list of species from all the great oceans, except perhaps the Antarctic, demonstrates their wide distribution, though they are always thinly scattered, so that, as regards some, only one sex is known. Moreover, whilst the littoral nemerteans as a rule form two marked groups of the Enopla and the Anopla (the armed, with the mouth in front of the ganglia, and the unarmed, with the mouth behind the ganglia). the pelagic forms fall under a section of the armed. They are further distinguished by their comparatively short, flattened, and, in some, translucent bodies, the walls of which are in marked contrast to the firmer tissues of the littoral forms, for the almost gelatinous parenchyma is largely developed. Further, some possess a caudal fin, and a few, in addition, a lateral fin. The dorsal and the ventral longitudinal muscles with vertical bands are best developed. Eyes are often absent and sense organs few and peculiarly modified. The typical proboscis and its sheath, with the armature of the former leaning to that in Drephanophorus, is present, though no mention is made by either Prof. Brinkmann or the present author of the remarkable corpusculated fluid in its sheath Moreover, the males of the pelagic group carry their spermaries in the cephalic region with or without penes, whilst the females follow the littoral nemerteans in having the ovaries arranged along the body-in this case interdigitating with the alimentary cæca Lastly, some males are provided with a pair of muscular tentacles anteriorly.

The monograph of Mr. Wesley R. Coe has appeared nine years later than that of Prof. Brinkmann,2 and thus has the advantage of that masterly treatise, the classification in which the author follows, namely. the order Holopnemertini of Hubrecht being divided into the sub-orders Polystylifera and Monostylifera. The former has two tribes, the Reptantia, including the family Drephanophoridæ, whilst the Pelagia has

1 "The Pelagic Nemerteans" By Wesley R. Coe. (Memoirs of the Museum of Comparative Zoology at Harvard College, Cambridge, U.S.A.) Vol. 49, pp. 242+30 Plates. 1926 2 Vide Nature, July 4, 1918, p. 353.

no less than nine families. Further investigations and discoveries may perhaps lead to changes and simplification, but in the meantime order is maintained. The treatise contains a description of the pelagic nemerteans obtained (1) off the west coast of Mexico, Central and South America, and the Galapagos Islands, (2) those from the eastern tropical Pacific, and (3) those from the North-West Pacific Expedition.

The collections were originally taken in hand by the late Dr. Woodworth, but, on his death, the task fell to Mr. Coe After an introduction, in which the history of the pelagic group is outlined, the author gives a general survey of their structure under the head of morphological peculiarities. He differs from Gerarda Wijnhoff and Brinkmann in not reckoning the layers of the proboscis as if it were entirely evaginated, and he gives the anterior region nine layers, the most remarkable of which is the main nervous layer with its numerous longitudinal trunks and reticulations, the whole forming a system far larger than the two original (anterior) nerves, and which misled the reviewer in 1868 in thinking it a reticulated nonnervous layer. Like Brinkmann, he does not allude to the corpusculated fluid in the cavity of the sheath. nor is any light thrown on the function of this complex organ. He points out the importance in a pelagic form of the dorso-ventral bundles of muscle which are interdiverticular in position, and he agrees with Brinkmann that the muscular tentacles in the males of certain forms may be of use in holding the females whilst the sperm-sacs shed their contents, though in the littoral forms it is sufficient for the male to be in the proximity of a spawning female to cause an immediate issue of a cloud of sperms. He describes the subcutaneous sense organs as differentiated parts of the integument, and alludes to peculiar organs in connexion with the dorsal nerve in Neuronemertes aurantiaca-hinting that they may be phosphorescent organs, but such is unproved.

The contrast with the littoral forms in sense organs is striking, and yet it might have been expected that a free-swimming race was more in need of them. Mr. Coe devotes much attention to the minute structure of the reproductive organs both in text and illustration. He concludes with remarks on their food, habits, parasites, and enemies, and a detailed description of the 47 species in the collections. The whole forms a notable and independent contribution to our knowledge of the group in text, text-figures, and plates, and is alike creditable to the Museum and W. C. M the author.

<sup>3</sup> Trans R. Soc. Edin., vol 25, pp 305-433

## Tribute to Prof. H. F. Osborn.

THE seventieth birthday of Prof. Henry Fairfield Osborn, president of the American Museum of Natural History, was celebrated by the presentation to him of a Queen Anne cup made by Thomas Folkingham in 1711, and an illuminated book containing an address of congratulation, with the signa-tures of his colleagues and friends all over the world These signatures were made on individual slips of vellum and included nearly a thousand names. The design and decorations of the book were executed by Mr. William E. Belanske. Owing to Prof. Osborn's absence from the city on Aug. 8—the date of his birthday—the Committee in charge of the celebration waited upon him at Garrison on July 28 to make the presentation. They also invited Prof. and Mrs.

Osborn to be the guests of honour at a reception to be given them on Sept. 29, on which occasion the balance of the birthday fund raised by his friends, amounting in all to nearly seven thousand dollars, will be presented to Prof. Osborn for his research work.

The congratulatory address in the album presented

to Prof. Osborn reads as follows:
"On your seventieth birthday your colleagues and friends join to salute you, to congratulate you, and to express their delight in finding you radiant in health

and spirit, joyously carrying on your life work.

"We desire to thank you most heartly for your leadership in many fields. Drawing around you in the American Museum of Natural History a staff of explorers and co-workers who are animated by your

spirit and who gladly enrol under your banner, you liave penetrated to the uttermost parts of the earth and have brought its natural history treasures to the Museum To your unceasing labours, as Curator of Palæontology and as President, we owe the series of



Fig. 1—The inscription on the base reads "To Henry Pairfield Osborn, master builder, upon the occasion of his seventieth birthday, August 8, 1927, from his friends"

unique exhibition halls at the Museum, where countless visitors pass before an impressive panorama of extinct life Thanks to your sympathetic understanding the school children of New York and their teachers enjoy all the educational and emancipative opportunities of the Museum's School Service. And in the near future the Museum will also display still other imposing evidences of your constructive genius when the Roosevelt Memorial Hall and the Akeley

African Hall take their places in the assemblage of buildings devoted to science and education.

'We desire also to express our admiration of the creative, tireless spirit which, during a life crowded with administrative work, has produced a series of publications, covering many hundreds of titles and ranging from buef articles in Natural History to the great monographs on the titanotheres and the proboscideans now in press
"We congratulate you upon the many distinguished

honours that the highest scientific tribunals of the world have awarded to you in recognition of your services to science We join the great company of your readers in acknowledging our indebtedness for such classic works as 'From the Greeks to Darwin,' 'The Origin and Evolution of Life,' 'The Age of Mammals,' and 'Men of the Old Stone Age'

'Princeton University will not forget your services when in 1877 as co-leader with your life-long friend Professor W B Scott, you led the first Princeton expedition to the fossil fields of Wyoning; or when, after your return from your graduate studies at Cambridge University, you brought the Huxleyan

gospel of comparative anatomy to your pupils. Columbia University has reason to remember the great part you played in planning and guiding the Department of Zoology in its formative period, nor will your old students, either of Princeton or of Columbia, ever forget what new worlds you opened to them and showed them how to enter

"The New York Zoological Society owes to you thirty-one years of brilliant service as Chairman of the Executive Committee and later as its President.

"From many parts of the world, therefore, your friends unite to testify their appreciation of your services as a leader in biological science, in education, and in the highest ideals of citizenship.

"We congratulate you again upon this unique record of service. We delight in the admirable spirit of fairness, generosity, friendliness, and comradeship which you have shown, not only to your colleagues but to the least of your assistants. And we rejoice with your devoted wife and your sons, daughters and many grandchildren, that this seventieth birthday finds you with forces unimpaired, still planning, still building, under the inspiration of a dauntless optimism."

## The Conservation of Forests.

TORESTRY propaganda, by which is understood the endeavour to cultivate a forestry 'sense' in the people, has been in force for some time in the United States of America. The unrestricted lumbering under which so large a proportion of the forests of the country have been ruthlessly destroyed by axe, saw, and fire, led to the introduction of a forest service and forestry societies. It became recognised, however, that before any efficient protection of the remaining forest areas and the rehabilitation of portions of those destroyed could make any real progress, the people and the big lumbering companies would have to be educated as to the real meaning and value of the forest to the community and the nation. Various steps have been taken during the last decade or two, but progress in the direction desired was admittedly slow Latterly this crusade has been taken up with renewed vigour, and the methods employed are worthy, not necessarily of imitation, but at least of study and consideration; for propaganda of a similar kind is urgently needed if the new woods now being created in Britain are not to suffer from acts of negligence or worse at the hands of members of the community, entirely un-

acquainted with the objects aimed at in bringing into being this form of national (as also privately owned) property.

Two notes in the Daily Science News Bulletin issued by the Science Service of Washington, exemplify the type of propaganda in force in the United States. The language used is simple, technical terms being avoided, in order that the matter may be readily understood by the man-in-the-street. The first of the notes is entitled "Forest Trees Wage Fierce Struggle for Existence." A simple description of the forest is given, pointing out the different methods of growth of a tree growing singly or in a crowded forest, with examples of species which naturally grow in pure woods as against those appearing in mixture. The effect of the tree on the soil, and its demands and so forth, are simply treated of, the writer summarising his note with the remark: "A forest is a complete plant society in which the individuals compete in a struggle for existence, help each other by co-operating in keeping soil, moisture, and climatic conditions favourable to all, and are helped or hindered by thousands of subsidiary forms of life."

The second note, "Conserve Trees by Selective

Felling," has not the same application in Great Britain. For some years the U.S. forest officers have been striving to educate the lumberers and to reduce the damage and waste which have resulted from the lumbering of the forests in the past. Under these practices most of the young growth, which is not of size to be converted into lumber, has been recklessly destroyed whilst extracting the logs; moreover, large amounts of slash and refuse are left on the areas which, being so inflammable, usually catch fire. the fire often spreading to and destroying neighbouring valuable forests. The loss in this way, both in the United States and Canada, has been enormous. The present note is designed to show, from actual proof on the ground, that it is possible to lumber, i.e. to cut in a forest under a system of selective fellings by which the younger growth, or age classes, of the forest are left unharmed; and that this method actually gives better financial returns per acre, whilst subsequent fire danger is greatly reduced, since little slash remains. A further advantage of major importance is that additional fellings will be possible on the area when the young growth conserved has reached exploitable size. figures and results attained as given in this note merit the careful attention of the lumberer, not only in the United States but also in Canada.

## University and Educational Intelligence.

Cambridge.—Dr. F. J. W. Roughton, Trinity College, has been appointed lecturer in physiology and Mr. J. D. Bernal, Emmanuel College, has been appointed lecturer in structural crystallography in the department of mineralogy.

Free displays of films illustrating life in the British Dominions and Colonies will be given four times daily on week days and once on Sundays at the Imperial Institute, South Kensington, during September The programme is as follows: Sept. 4-7, Australia. New Zealand, and Canada; Sept. 8-10, South Africa and Australia; Sept. 11-14, South Africa, East Africa, Malaya, West Indies, Fiji, Sept. 15-17, India, Gold Coast; Sept. 18-21, Nigeria, Palestine; Sept. 22-24, Canada, British Guiana; Sept. 25-28, New Zealand, Sept. 29-Oct. 1, Canada and Australia. Teachers wishing to take organised parties of school children are advised to notify the Secretary, Imperial Institute, at least three days in advance of the proposed visit.

UNDER a recent regulation, the Board of Research Studies at the University of Cambridge now issues annually a volume of abstracts of the dissertations which have been approved for the research degrees (other than for the higher doctorates which are awarded on general published work at a later stage of a graduate's career). This volume will be useful as a guide to the ground covered by a piece of research where the complete work is only accessible in the University library. The need for it does not arise when the work is published in the standard scientific or literary periodicals, but the present pressure on the space of these journals makes it growingly difficult to publish work in full, and this summary of work may well fill a real gap. The summaries are arranged by faculties, and it may be of interest to note that the departments most largely represented are chemistry ten, physics and biochemistry six each, and botany five. On the literary side, history is the only faculty with a comparable output. Of the graduates, eight come from Caius and from Trinity, five from Emmanuel, while Corpus Christi, Jesus, King's, Queens' and Selwyn are all unrepresented. The research graduates are fairly evenly divided between graduates of Cambridge and graduates of other universities. The steady development of the research degree work at Cambridge is of considerable interest and importance.

'JUNIOR' colleges, offering the courses ordinarily taken during the first two years of the four-year college of liberal arts, are rapidly increasing in number in the United States, and are causing much attention to be focussed on the organisational relationship between the secondary schools and the universities and degree-conferring colleges This subject is dealt with m a closely reasoned and illuminating article contributed by Prof. Leonard V Koos of Minnesota to the May number of School Life, the official organ of the United States Bureau of Education. The main purpose of the article, publication of which is sponsored by the National Committee on Research in Secondary Education, is to show that present-day conditions point to the desirability of the integration of the junior college with the grades and work of educational units immediately below it—of definitely mcorporating it, in fact, in the secondary school system. Prof Koos first exposes the fallacies of the chief arguments which have been adduced for the separation of the public junior colleges from the grades of the 'high' school below, namely: the advantage in 'selling' the jumor college to the community, encouragement of the development of college life,' and safeguarding the standard of work He next points out that experience with other twoyear units, like the two-grade jumor high school and the normal school, has been unsatisfactory. His main arguments are that a review of reorganisation of secondary and higher education during the past hundred years shows the essential similarity of the purposes of education in high-school and juniorcollege years, and that their separation involves deplorable overlapping and waste of time.

The Carnegie Endowment for International Peace has Divisions of (1) Intercourse and Education. (2) International Law, and (3) Economics and History. The work of Division (1) during the year 1926 is described in a report, dated April 2, by its Director. Dr. Nicholas Murray Butler, who is also president of the Endowment and chairman of its executive committee. Of the total disbursements of the Division in the year, amounting to 363,663 dollars, the largest items were a grant-in-aid for the library building of the University of Louvain (50,000 dollars), and the expenses of a trip to Europe of American professors of international law and relations (63,312 dollars). Among the many activities for the promotion of which the rest of the expenditure was incurred were those of the International Relations Clubs, which are now established in 116 educational institutions in the United States. The members are chiefly undergraduates. The Division prepares for them fortughtly summaries of international events and supplies them with books and pamphlets. A handbook describing the work in detail is obtainable from the office at 405 West 117th Street, New York. The Division is responsible for the publication of "International Conciliation," a series of bulletins, begun in 1907, including texts of official treaties, articles by eminent statesmen, etc. The Centre Européen, maintained by the Division at a cost of 20,000 dollars yearly, published in January the first number of a quarterly, L'Esprit International. Its Directeur-Adjoint has recently conferred with the British Institute of International Affairs with the view of co-operation on lines already found effective in connexion with the Institut des Hautes Études Internationales and the Deutsche Hochschule für Politik, in which a Carnegie chair of international relations has been founded.

## Calendar of Discovery and Invention.

August 28, 1789.—The most magnificent of ighteenth-century telescopes, the great forty-foot effector built by Herschel at Slough, was begun in 785 and finished in 1789. It was built at the xpense of George III. Herschel gave a description of it in the Philosophical Transactions in 1795. The irst mirror was placed in the tube in February 1787 but was unsatisfactory; the second was cast in anuary 1788 but cracked, while the third and last was east a month later. On Oct. 24 of that year faturn was observed with it, but, said Herschel, not being satisfied, I continued to work upon it ill Aug. 27, 1789, when it was tried upon the fixed tars and I found it to give a pretty sharp image. Then he continues, "Aug. 28, 1789, Having brought he telescope to the parallel of Saturn, I discovered a ixth satellite of that planet, and also saw the spots ipon Saturn better than I had ever seen them before; to that I may date the finishing of the 40-feet telecope from that time."

August 29, 1864.—From his spectroscopic examination of the stars, Huggins turned to the examination of the nebulæ, and on Aug 29, 1864, he applied his spectroscope to a planetary nebula in the constellation Draco. It was then, to his surprise, that he saw a spectrum of bright lines, thus proving that the

nebula was a mass of glowing gas.

August 29, 1799.—Among famous steam-engine patents is that of William Murdock dated Aug. 29, 1799, for the D-shaped slide valve which in modified form is the commonest type of valve used in steam engines to-day. It took the place of the four poppet valves of Watt, who afterwards wrote. "When Mr. Murdock introduced the slide valve, I was very much against it, as I did not think it so good as the poppet valve, but I gave in from its simplicity."

August 30, 1576.—On this date the foundation stone of the famous Uraniborg, Tycho Brahe's great observatory on the island of Hven, was laid. One of the most remarkable instruments employed was the mural quadrant with which the altitude of the celestial bodies could be observed with far greater

accuracy than hitherto.

August 31, 1857.—The first of the great Alpme tunnels, the Mont Cenis, was begun on Aug. 31, 1857. Steam was originally used for driving the drilling machines, but, through Colladon, compressed air was utilised. The engineers of this great undertaking were Grattoni, Grandis, and Sommelier. The tunnel is 7½ miles long and cost £2,600,000. On Sept. 13, 1871, an experimental train was run through it and the tunnel was inaugurated four days later. The other great Alpine tunnels are the Simplon, the St. Gothard, the Lotschburg, and the Arlberg.

September 3, 1832.—From Oersted's discovery came those of Ampère, Arago, Sturgeon, and Faraday, while immediately after the publication of Faraday's work a group of inventors began to apply his discoveries. Among this group was H. Pixii, an instrument maker of Paris, who produced a magneto machine in 1831, and on Sept. 3, 1832, completed a machine with a commutator, in which a permanent magnet was revolved in front of a soft iron horse-shoe magnet with bobbins of insulated wire.

September 3, 1860.—In the splendid collection of meteorological instruments at the Science Museum, South Kensington, are many interesting records, including the first Daily Weather Report issued in England. This is dated "London. September 3, 1860." The particulars given are: Bar.: 30.13 in. Temp.: shade 58°. Wet bulb, 54°. Wind, W. Force of wind, 2. Cloud, 2. Sky blue. E. C. S.

## Societies and Academies.

#### PARIS.

Academy of Sciences, July 18-G Bigourdan. The differential determination of time with high precision .-- A Desgrez and J. Meunier The presence of lithium and strontium in the teeth and in human The existence of bones. Their chemical condition lithium and strontium as normal constituents of bones and teeth is definitely established. Lithium is present as phosphate and strontium as carbonate.—Léon Guillet. The properties of pure aluminium. Aluminium containing 99 8 per cent. of the metal is now commercially obtainable. Details of its electrical and mechanical constants are given. These do not differ greatly from those of the ordinary aluminium containing 0 5-1 per cent. of impurities.—Louis Ravaz was elected correspondant for the section of rural economy in succession to the late A. Balland—Georges Bourguignon Chronaxy of the muscles of the leg of the rabbit. Comparison with the chronaxy of the leg muscles of man in the normal state and in lesions of the pyramidal bundle.—Eugène Slutsky A limiting theorem relating to series of eventual quantities.—Edm Lahaye. A new method of mtegration of certain groups of differential equations. S. Stoilow · Continued transformations and Picard's theorem on integral functions—René Lagrange: Certam suites of polynomials. — Krawtchouk: The poles of meromorph functions.—D. Riabouchinsky. Fluid movements round infinitely near soluls.—Henri Mémery: The sun and the atmosphere. In attempts to find a relation between variations of solar phenomena (sunspots) and temperature variations in western Europe, results are more likely to be obtained by making comparisons each day than by using annual averages—J Struik and Norbert Wiener · The relativist theory of quanta.—H. L. Vanderlinden: The fine spectrum structure in the gravific field of the sun.-R. Anthouard. The conditions of discontinuity of discharge in gases Considering the tube through which the discharge passes as a condenser, a formula is developed which has been experimentally confirmed.—Max Morand. The distribution of the electric field in the dark space. E. Delauney: The atomic character of some properties of the X-rays. Experiments with irradiated mixtures of barrum chloride and strontium chloride show that the numbers obtained for the intensity of the fluorescence do not follow the additive law; the mtensity of fluorescence increases much less rapidly than the proportion of barum chloride -Ny Tsi Ze Changes in the optical properties of quartz under the influence of the electric field .- Paul Soleillet: The influence of the magnetic field on the polarisation of the resonance radiation of cadmium -Ch. Bouhet: The elliptical polarisation produced by reflection at the surface of liquids—A. Andant and E. Rousseau The resonance power of some metallic salts irradiated by filtered light from a mercury arc The phonomenon of resonance in the presence of a manganese salt described in a previous communication, is not an isolated experimental fact. The same phenomena are found in the presence of salts of magnesium, sodium, potassium, and uranium—P. Bonèt-Maury: The vaporisation of polonium Experimental results obtained by the method described in an earlier communication.—M. Wilmet: A method for the rapid estimation of hydrogen phosphide in a gas mixture. The gas is allowed to react with a solution of mercuric chloride and the hydrochloric acid produced determined volumetrically.-V. Auger and C. Eichner: A compound intermediate between

vanadium sulphate V<sub>2</sub>O<sub>5</sub> . n SO<sub>3</sub> and vanadyl sulphate -(VO) SO<sub>4</sub>.—W N. Ipatieff and B N Dolgof. The nydrogenation of tetraphenylmethane and p-oxytetraphenylmethane under pressure. With hydrogen under 80-100 atmospheres pressure and at 275°-285° C., tetraphenylmethane gives cyclohexane and tricyclohexylmethane hexylmethane p-oxytetraphenylmethane under similar conditions gives cyclohexanol, dicyclohexylmethane and some tricyclohexylmethane —Jacques de Lapparent. The texture of bauxites and their origin.—G Dubar: The metamorphic strata of Betchat (Ariège).-F. Dienert: The influence of the soil on the cooling of waters — E. Blanchard and J. Chaussin: The antagonism between chlorides used in large quantities and sulphates on the course of the development of wheat and oats.-J. Pien. The influence of calcium cyanamide on the reaction of the soil. Calcium cyanamide causes an increased alkalinity of soil for five to ten days: later, there is a slight reduction, but the final result is a clear variation of the pH of the soil towards alkalinity.-Th. Bieler-Chatelan: Chestnuts, ferns, and brooms. In spite of their preference for soils containing little or no chalk, the chestnut, fern, and Spanish broom may flourish in places where calcium carbonate renders the soil distinctly alkaline — P. Petit and Richard The saccharification of the dextrins.—Charles Pérez A protelian parasitism of Nectonema. -F. d Herelle and E. Peyre: Contribution to the study of experimental tumours.—Daniel Chevrier and Max Salles: The sterilisation of potable waters by electrolysis. The apparatus proposed consists of a metal tube forming the cathode with a fine platinum wire, placed along the axis of the tube, as anode. The voltage used is 110 to 120 volts.—Roger Douris and Charles Mondain: The differentiation of pathological sera by means of their dehydration figures.

#### CAPE TOWN.

Royal Society of South Africa, June 15 .- B. F. J. Schonland: The exchange of electricity between thunderstorms and the ground. Measurements were made in the summer of 1927 at Somerset East to determine the nature and magnitude of the exchange of electricity between thunderclouds and the earth. Seventeen active storms have been observed to pass over the station, all of which produced strong negative fields below them. Taking the average amount of electricity discharged in a flash to earth and the average interval between such flashes as 20 coulombs and 120 sec. respectively, the effect is equivalent to a current of 0.17 amp. The effect of point discharge was estimated by setting up a typical thorn-tree (Acacia Kaffra) on sulphur insulators and determining the average value of the current leaving the tree when the thundercloud was overhead. This amounted to 0.9 micro-amperes, averaged over an area of 50 sq. km. beneath the cloud. The total number of such trees in this area was estimated at 2.0 × 106, so that the upward discharge of electricity from them would amount to 1.8 amp The effect of the charge carried down by rain was negligible in comparison with that due to the flash and point discharges. The net result is a current of about 2 amp. between the bases of the clouds and the ground in such a direction as to give a negative charge to the earth.-J. H. Power: On the herpetological fauna of the Lobatsi-Linokana area.

#### GENEVA.

Society of Physics and Natural History, July 7.—R. Chodat and F. Mayer: The production of carotine in pure culture of green algae. It is possible to vary at will

calcium nitrate are added Maximum production occurs in a medium poor in assimilable nitrogen.-R. Wavre. Remarks on the stratification of the planets. The author demonstrates the following proposition: if the density  $\sigma\left(x,y,z\right)$  admits of first and second partial derivatives throughout the mass, the angular velocity and external surface being given. if a stratification exists with relative equilibrium without absolute rest, this stratification is unique.-Pierre Dine: General movements of rotation of the heterogeneous fluid mass and geodesy. The author proves the following fundamental propositions · whatever may be the law of flattening of surfaces with density constant, there exists an angular velocity of rotation, definite at each point of the mass and capable of maintaining its molecules in a state of uniform and permanent rotation. This angular velocity decreases constantly from the centre to the surface and from the pole to the equator, except perhaps in two extreme cases, one of which includes the particular case of Clarraut. In a heterogenous fluid in rotation, stratified in homothetic ellipsoidal layers according to Roche's law of densities, the square of the angular velocity of a molecule is a rational algebraic function of the co-ordinates of this molecule. —R Cherbuliez and G de Mandrot A new method of splitting up proteids. The proteid materials dissolve on heating (150°-200° C.) with acid amides. Acetamide extracts from casein, with a yield of nearly 100 per cent., a substance of the same percentage composition in carbon, hydrogen, and nitrogen, but possessing very different physical and chemical properties. The question arises as to whether there is a simple depolymerisation.—W. N. Schopfer: Researches on the influence of the nutritive medium on the formation of the zygotes in the heterothallic Mucorineæ. The study of Mucor hiemalis shows that in a sugar (maltose) nitrogen medium there exists, for the formation of zygotes, an optimum concentration characterised by a high proportion of sugar.— M. Gysin and C. Couchet: Remarks on the methods of analysis of platinum minerals. The authors have submitted to a very detailed control Thuringer's method and that used in refineries. Neither method gives a complete separation of iridium.—A. Naville: Fertilisation and the chromosome cycle of Chloromyxum Leydigi. Studying the evolutive cycle of Chloromyxum Leydigi, the author shows that in this species there should be two successive fertilisations, one isogamous after the formation of the spore, the other anisogamous before the formation of the spores This hypothesis reconciles the two theories concerning the fertilisation of the Myxosporidieæ and possesses the advantage of explaining all the figures of Keysselitz.

the quantity of carotine produced by algae in a nutritive

medium of glycogen to which suitable proportions of

## Official Publications Received.

#### BRITISH.

Department of Scientific and Industrial Research Report of the

Department of Scientine and Industrial Research
Food Investigation Board for the Years 1925, 1925
Power of the Power 1925, 1925
Power 1925
Powe

9d. net.
Ordnance Survey. Report on the Experimental Revision of the 1/2500
Ordnance Survey Plans with the Aid of Photographs taken from the
Air. Pp 1: (London H M. Stationery Office) 4d. net
A List of Official Chemical Appointments, compiled by direction of
the Council of the Institute of Chemistry and under the Supervision
of the Publications Committee by the Registrar of the Institute. Sixth
edition, revised and enlarged. Pp 335 (London: Institute of
Chemistry.)

Ministry of Agriculture and Fisheries. Intelligence Department Report on the Work of the Intelligence Department of the Ministry for the Two Years 1024-23 Pp 86 (London H M Stationery Office)

for the 1WO rears 10-3-10 ap composed Society Vol 88, Part 2 The Quarterly Journal of the Geological Society Vol 88, Part 2 No 380, July 10th Pp xhx-cxi+195 345 (London Longmans, Green and Co. Ltd.) 78, 201.

Agricultural Experiment Station, Michigan State College of Agriculture and Applied Science Circular Bulletin No 104: Clothes-Moths and Caipet-Beetles. By Eugena McDaniel. Pp 20 Special Bulletin No 103 Forest Planting in Michigan. By Alfred K Chittenden Pp 24 Technical Bulletin No 70 Tests for Incipient Putrefaction of Meat By Ralph H Weever Pp 28 (East Lansing, Mich.) Technical and Scientific Supplement to the Record No. 2 Report on Cottons from Siam By Sir George Watt Pp 6 (Bangkok Ministry of Commerce and Communications.) 50 satangs

Meddelelser fia Kommissionen for Hardingerser Serie Fisker, Binds Nr. 3 A Bottom Sampler for Hard Bottom, by Martin Knudsen, Nr. 4 Preliminary Experiments with Knudsen's Bottom Sampler for Hard Bottom, by A.C. Johansen Pp 44- Nr. 5 Quantitative Investigations of the O-Group and I-Group of the Plaice, Turbot, Bill and Sole in the Skagerrak, Kategat and Belt Sea By Anton Fr Bruum Pp 30 (Kobenhavn, C. A Reitzels Forlag.)

Skrifter udgivne at Kommissionen for Dammarks Fiskeri- og Havundersogelser No. 10 Om Hummerlen og Hummertskeriet i de Damske Farvande. Af Erik M Poulsen Pp 42. (København; C. A Reitzels Forlag.)

Berichte der Naturforschenden Gaselbehoft zu Eraburg. By Havange.

Britchte der Naturforschenden Gesellschaft zu Freiburg i Br Heiausgegeben von Piof. Dr. J. L. Wilser. Siebenundzwanzigster Band, Zweites Heft. Pp. 47+20+4+5+8+98 (Freiburg i Br. Speyer und Siebenundzwanzigster Band, (Freiburg i Br Speyer und

## Diary of Societies.

#### CONGRESSES.

AUGUST 27-SEPTEMBER 1

International Congress of Orientalists (at Oxford) In following sections. General (including Anthropology, Ethnogiaphy, Prehistoric Archeology, Comparative Mythology, and Folklore), Assyriology and cognate subjects, Egypt and Africa, Central and Northern Asia, the Far East, India and Iran, including the Indo European Languages of Asia the Old Testament, the Language, Literature, etc., of Islam, and Oriental Art

AUGUST 29-SEPTEMBER 3

INTERNATIONAL COMMISSION FOR THE EXPLORATION OF THE UPPLR AIR (at Leipzig)

AUGUST 31-SEPTEMBER 3.

WORLD POPULATION CONFERENCE (at Geneva)

#### AUGUST 31-SEPTEMBER 7

British Association for the Advancement of Science (at Leeds).

Wednesday, August 31, at 8 30 pm.—Sir Arthur Keith Darwin's Theory of Man's Descent as it stands To-day (Presidential Address).

Thursday, September 1, at 10 am.—Addresses by Sectional Presidents:

B (Chemistry)—Dr N V Sidgwick Co-ordination Compounds—D (Zoology)—Dr. G P. Bidder The Ancient History of Sponges and Animals—E (Geography)—Dr. R N Rudmose Brown Problems of Polar Geography.—G (Engineering).—Sir J B Hendelson: Invention.

—K (Botany)—Prof. F E. Fritsen: Some Aspects of the Present-day Investigation of Protonbuta.

—A (Botany)—Frot. F. E. Fritsch: Some Aspects of the Fresent-day Investigation of Protophyta.

At 11 A.M.—F (Economics)—Prof. D. H. Macgregor Rationalisation of Industry.—M (Agriculture).—C. G. T. Morison: Agriculture and National Education.

At 2 P M.—Conference of Delegates of Corresponding Societies
At 2 30 P.M.—Discussion (Sections J. L): The Psychology of Special
Scholastic Disabilities.

Scholastic Disabilities.

Friday, September 2, at 10 a.m.—Addresses by Sectional Presidents: A (Mathematical and Physical Sciences)—Prof. E T. Whittaker: The Outstanding Problems of Relativity—H (Anthropology).—Prof. F. G. Paisons: The Englishman of the Future.—I (Physiology).—Dr. C. G. Douglas: The Development of Human Physiology—Discussion (Section G): Coal.—Discussion (Sections K. M): The Control of Plant

At 11.30 A.M —Address by the President of Section L (Education), Her Grace The Duchess of Atholl The Broadening of the Outlook in Education

At 8.30 PM —Evening Discourse by Prof. R. A. Millikan: Cosmic

Rays.

Monday, September 5, at 10 A.M.—Addresses by Sectional Presidents: C (Geology).—Dr. H. H. Thomas: Centres of Tertiary Volcanic Activity in Britain.—J (Psychology).—Dr. W. Brown. Mental Unity and Mental Dissociation.—Discussion (Sections A. B): The Structure and Formation of Colloidal Particles.—Discussion (Section G). Lubrication At 8.30 F.M.—Evening Discourse by Dr. F. A. E. Crew. The Germplasm and its Architecture.

Tuesday, September 6, at 10 A.M.—Discussion (Sections C. K, and Cosmical Physics Department of Section A): Climates of the Past.—Discussion (Sections F. J): Innate Characteristics and Social Difference.

At 2 P.M.—Conference of Delegates of Corresponding Societies.

Wednesday, September 7, at 12 NOON.—Concluding General Meeting.

#### SEPTEMBER 1-4.

Schweizerische Naturforschende Gesellschaft (at Basel) (in 14 Sections), as follow:—Medical, Biology (Prof. R. Stachelin, President); Chemistry (Prof. H. Rivier, President); Physics (Prof. P. Debye, President); Geophysics, Meteorology, and Astronomy (Prof. S.

No. 3017, Vol. 120]  Mauderh, President), Mathematics (Prof F Gonseth, President), Pharmacy (J Lang, President), Geology (Prof A Jeannet, President), Mineralogy and Petrography (Prof M Rheinhard, President), Paleontology (Di A. Tobler, President), Zoology and Entomology (Prof A Reichenspeiger, President), General Botany (Prof E Wilczek, President); Systematic Botany and Plant Geography, Anthropology and Ethnology (Prof. R Zeller, President), History of Science and Medicine (Prof G Senn, President), History of Science and Medicine (Prof G Senn, Presidenty), The Causes and Factors of Moiphogenesis, by Prof A. Brachet, Recent Work and Views in Astronomy, by Prof L Courvoisier, The Urals from the Point of View of Geophysics, Geology, and Mining, by Prof L. Duparc; Paracelsus in Relation to Modein Thought, by Prof H. E. Sigerist.

#### SEPTEMBER 3-10

International Union of Geodesy and Geophysics (at Prague)

International Union of Geodesy and Geofhysics (at Prague)

Engire Mining and Metallurgical Congress

Il innipeg Mecting, September 3 — G E Cole The Development of Gold

Mining in Canada — W A Quince Methods of Eliminating Barren

Rock from Ore at the Sub-Nigel Mine — C R Dauls, J L Willey, and

S. E T Ewing Notes on the Operation of the Reduction Plant at

West Springs, Ltd — E J Laschinger A New Form of Air Meter and

the Measurement of Compressed Air

Vancouver Meeting, September 14 — C P Browning Canadian Copper and

its Production — F J Alcock and T W Bingay Lead and Zinc in

Canada — C. J N Jourdan A Brief Review of the Principal Base

Metal and Base Mineral Resources of the Union of South Africa — R

Craib Dewatering the Lower Levels of the Simmer and Jack Mines,

Ltd — W S Robinson Manufacture of Sulphure Acid by the Contact

Process From Zinc Blende Roaster Gases

Edmonton Meeting, September 20 — R Strachan, W J Dick, and R J

Lee The Coal Industry in Western Canada — J Ness Petroleum in

Canada — A Docquier, L Bataille, and R Beetlestone A Combina
tion of the Baum, the Draper, and the Froth Flotation Systems as

applied to the Washing of Coal at the Linis Mine of the Kailan Mining

Administration, North China — A E Cameron Impact Resistance of

Steel at Low Temperatures

Quebec Meetings, September 5 and 26 — J G Ross Asbestos Mining and

Milling — A W Nash Possible Auxilian Sources of Liquid Lend —

Steel at Low Temperatures
Quebec Meetings, September 5 and 26 — J G Ross Asbestos Mining and
Milling — A W Nash Possible Auxiliary Sources of Liquid Fuel —
A Job: The Sinking and Equipment of the Ventilation Shaft of the
Government Gold-Mining Areas — G W. Sharp The Tipping and
Guiding of Vertical Skips — P. M Newhall and L. Pryce. Improvements in Drilling Efficiency with Jack-Hammers
Sydney Meetings, September 9 and 10 — F. W Gray Mining Coal Under
the Sea in Nova Scotia.—Sir Robert Hadheld. The Metal Manganese
and its Properties also, the Production of Ferio-Manganese and its
History—Raw Materials for the Iron and Steel Industry in India—
B Yaneske The Manufacture of Steel in India, by the Duplex
Process.

#### SEPTEMBER 4-0

International Congress of Zoology (at Budapest)

#### STPTEMBER 6-9.

Institute of Metals (Autumn Meeting) (at Deiby)
Tuesdam, Scylember 6, at 8 F.M.—Dr. L. Aitchison. Non-Ferious Metals in Modern Transport (Lecture).
Wednesday, September 7, at 10 a M.—Reading of Papers selected from \*
Thursdam, September 8, at 10 a M.—Reading of Papers selected from \*
Thursdam, September 8, at 10 a M.—Reading of Papers selected from \*
Friday, September 9.—All-day Excursion.

\*W. T. Cook and W. R. D. Jones. The Copper Magnesium Alloys Part II.—W. Hume-Rothery: Researches on Intermetallic Compounds VI. The Reaction between Solid Magnesium and Liquid Tin.—K. L. Meissner. Age. Hardening. Tests with Elektron Alloys.—A. R. Raper. The Equilibrium Diagram of Copper-Tin Alloys.—Ontaining from 10 to 25 per cent of Tin.—C. S. Smith. Note on Cathodic Disintegration as a Method of etching Specimens for Metallography.—H. Sutton and A. J. Sidery. The Protection of Aluminium and its Alloys against Corrosion.—H. Sutton and J. W. Willstrop. The Nature of the Film produced by Anodic Oxidation of Aluminium.—Dr. C. J. Smithells, W. R. Pitkin, and J. W. Avery. Grain Growth in Compressed Metal Powder.—Marie L. V. Gayler. The Undercooling of Some Aluminium Alloys.—A. G. C. Gwyer and H. W. L. Phillips. The Constitution of Aluminium with Silicon and Iron.—F. Hargreaves: Effect of Work and Annealing on the Lead-Tin Eutectic.—W. Hume-Rothery and S. W. Rowell. The System Magnesium-Cadmium.—C. H. M. Jenkins. The Constitution and Physical Properties of Some of the Alloys of Copper, Zinc, and Cadmium.

## September 11-17

International Congress of Physics in Commemoration of the Centenary of Volta (at Como).

#### SEPTEMBER II-18

International Congress of Generics (at Berlin) In three sections: General Genetics and Cytology, Heredity in Man and Eugenics, Animal and Plant Breeding.

#### SEPTEMBER 12-14.

INTERNATIONAL SOCIETY OF LEATHER TRADES' CHEMISTS (BI-Annual Conference) (in London).

#### SEPTEMBER 18-OCTOBER 3

International Congress of Theoretical and Applied Limnology (at Rome) In four sections 'Physics and Chemistry, Geology and Hydrography, Biology, and Applied Limnology

#### SEPTEMBER 20-22.

IRON AND STEEL INSTITUTE (Autumn Meeting) (at Glasgow).



## SATURDAY, SEPTEMBER 3, 1927.

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## Man and his Ancestry.

SIXTY-NINE years ago. at the British Association assembled in Leeds, Sir Richard Owen, the first anatomist of his age, poured scorn on the theory of man's descent from an anthropoid stock, a theory which the president of to-day, another distinguished anatomist, regards as unshakable. Since the publication of "The Descent of Man" in 1871, we have come to know more than a little of the precursors of Homo sapiens, and this direct evidence of anthropoid ancestry has been corroborated on many sides. Thus the blood of man and that of the great anthropoid apes gives almost the same reaction; in the anthropoid brain are to be recognised all those parts which have been magnified in man, we find the same vestigial structures or 'evolutionary post-marks' in apes and in ourselves, the embryos of the two stocks develop along the same main path; the anthropoid mother fondles, nurses, and suckles her young in the human manner. "The fundamentals of Darwin's outline of man's history remain unshaken."

With his characteristic frankness, Sir Arthur Keith admitted, in his carefully restrained and vividly phrased address, that we have to correct some of the early blunders. Thus man's descent has not been in a straight line, one offshoot has given rise to another after a fashion that might be compared to a cymose inflorescence. "It is among a welter of extinct fossil forms which strew the ancient world that we have to trace the zigzag line of man's descent." We no longer expect to find an orderly file of extinct stages in which every part of the body becomes, as we advance, a little less ape-like, a little more man-like. For we know that this en bloc orderly advance is not usually disclosed in evolutionary series. While one part of the body moves forward, another often lags behind.

The distinctiveness of man, even of tentative men, Hominids before Homo, is in his big brain. Is there any light on the conditions of this advance? Being, as became a president, in a cautious mood, Sir Arthur Keith declared that there is not as yet any explanation to offer, yet he proclaimed with no uncertain voice that "Man has reached his present state by the action and reaction of biological forces which have been and are ever at work within his body and brain" Much depends on what is meant by "biological forces," and we wish to linger over the crucial question: How did man get his big brain?

Sir Arthur referred to Sir Ray Lankester's observation that an increase in the size of the brain

occurred not in the ancestors of man alone, but in diverse branches of the mammalian stock in the Miocene period. Was there at that time some environmental stimulus prompting cerebral advance, or was it the outcome of an age-long evolutionary trend in the course of which brams had largely superseded brawn? Also, is there not some elucidation in Prof. Elliot Smith's view, supported by an eloquent series of brains, from tree-shrew to ape, that the arboreal habit put a premium on variations in the direction of an increased neopallium, with special enlargement of particular areas, such as those concerned with visualising and manipulating, with a corresponding decrease of others, notably the olfactory centre? When, also, the uplift of the Himalavas and the shrinkage of forests brought the precursors of man back to solid earth, enriched by an arboreal apprenticeship, would there not be many a reason why variations in the direction of better brains should be fostered? For these tentative men would find themselves in a new environment, with new competitors, and therefore with increased need for standing by one another in little troops. But the beginning of society served as a shield over variations which had much less chance under an each-for-himself regime, and over helpless stages of early infancy and old age, the former ensuring a better future through education, and the latter a conservation of traditional wisdom.

Would it not be in these groups of families that the transition was made from words to language, that is to say, to the expression of simple judgments by means of socially significant imitated sounds. As these auditory symbols were added to visual ones, an incalculable addition was made to the capacity for ideation. became much easier with words as counters. gradually the meshes of the selective sieve were altered to favour variations in cerebral capacity. That the origin of these variations remains obscure is true enough, but that is not a particular puzzle affecting the ascent of man; it applies to all emergences of the distinctively new. The frequency of cerebral variability in man is obvious in almost every family; the problem of the origin of variations is relevant throughout the whole of animate Nature.

As animals become cleverer, it is increasingly possible for them to have smaller families; other things equal, an economy in reproduction has survival value. But the reduction of the number of offspring, made possible by quickened wits and enhanced parental care, favours family life and creates an atmosphere which is selective towards No. 3018 Vot. 1201

Carlos Carlos Anti-

variations in the line of affection, kin-sympathy, and conversation. All these evolutionary processes of the subtler type work round in virtuous circles. Again, we cannot but inquire, on a more physiological level, whether there was not much shrewdness in the old suggestion of Robert Chambers, that prolonged gestation was a factor in evolution If the conditions of life, such as sociality or seclusion, as in elephants and Peripatus respectively, allow of prolonged gestation, there is obviously an opportunity for the offspring being born at a relatively advanced stage, able very soon to fend for itself if need be. One may contrast the newborn foal with the new-born kangaroo shunting back of the developing period into the antenatal arc of the life-curve allows of a safe and sequestered differentiation of the nervous system without very much being asked of it, allows of a suppression of much of the repertory of instinctive capacities, so necessary when the creature is born at a less finished stage, and allows of the more successful development of plastic intelligence.

The prolonged infancy, so characteristic of Primates, would operate like the prolonged gestation in allowing a longer period for brain development before responsibilities intrude. Even if the number of cerebral neurons does not increase after birth, there are ramifications and linkages to be The prolonged infancy, increasingly established ensured by the incipient sociality with its division of labour, would react on the parents and help to form a sieve that favoured the wiser and kindler There is much truth in Rousseau's saying: Man did not make society, society made man.

These are some of the suggestions that might be made towards an elucidation of the problem of anthropus, with his small and simple brain, the advance was not initial, but after a footing in the struggle for existence became surer. It may of course be said that variations in the regulative system—in hormone production in particular stimulated brain development, and were associated with temporal variations in the relative length of the antenatal and infantile arcs in the trajectory of life; and Sir Arthur evidently looks to hormonekeys to open locks to which they have not yet been fitted by the evolutionist ' But our suggestion is that more must be made of the psychical and social factors in man's emergence.

What seems to us most distinctive in Sir Arthur Keith's position is his suggestion that racial evolution will become more intelligible when it is seen in the light of individual development. It is traditional to consider ontogeny in the light of phylogeny, and that illumination cannot be dispensed with. but there has not been adequate consideration of phylogeny in the light of ontogeny. "When we have discovered the machinery of development and of growth we shall also know the machinery of evolution, for they are the same." Slight changes in developmental rate and rhythm, slight oscillations in the co-ordinating and regulating influences, slight relaxations and tightenings of hormonic control, and the developing organism is altered, as we know, both for good and ill. We understand Sir Arthur to suggest that these developmental variations have furnished the raw material which the processes of selection have sifted

There we must walk warily. Is it not the case that variations often appear in embryos before there is any differentiation of endocrinal glands, and in many organisms where hormones are experimentally unknown? Moreover, all the wobblings in developmental regulation, whether hormonic or otherwise, have themselves to be accounted for If they are environmentally induced, will it not imply postulating the hereditary transmission of acquired modifications, or a remarkable persistence of the same environmental influence during the ages in which a particular trend of evolution—such as the differentiation of the neopallium—has been in progress?

It may be suggested that a deeply saturating environmental influence, climatic for example, may affect the germ cells along with the body in such a way that the regulative system is perturbed. But unless we can define these environmental influences, we are almost back to Darwin's confession of ignorance, unless, indeed, we are led to an almost providential view of what has been called 'the fitness of the environment.'

It cannot be doubted that a deepened knowledge of development—especially through experimental embryology—will throw light on evolution, but it is going a long way to say that their problems are the same. The germ cell starts with a repertory of initiatives, including not only factors but also regulations of these, and this repertory presupposes evolution. Again, if an individual embryo suffers some regulative perturbation in a non-fatal degree, it can within limits effect automatic adjustments, but this is very different from the active way in which many an organism plays its hereditary cards in relation to alterable circumstances. There is more than machinery when a higher animal shares

in its own evolution, even sometimes selecting its environment. In the evolution of the higher animals at least, the personality of the creature counts and though the personality may doubtless be influenced by the hormones, this does not alter the fact that the organism plays its own game for better or worse. This is what Prof. James Ward was driving at in his emphasis on what he called 'subjective selection'

Sixty-nine years ago Sir Rıchard Owen told his Leeds audience that mankind required an altogether separate order in the animal kingdom, but what Sir Arthur Keith followed Darwin in emphasising was man's solidarity with the rest of creation. Few, we think, will read the presidential address of 1927 —dignified, responsible, and pithy—without admitting the convincingness of the evidence that "Man began his career as a humble primate animal" There is danger perhaps lest we underestimate the magnitude of this hard-won conclusion and its mysteriousness For we must think not only of man primitive and tentative, but also of man as minister and interpreter of Nature, man as poet and painter, discoverer and saint. We must estimate everything by its best, and then what a piece of work is a man!

Using the word emergence does not solve any problem, but it expresses a mode of becoming that has often occurred. A combination of two gases, oxygen and hydrogen, results in the production of water with entirely novel and in some measure unpredictable properties; so there has been in organic evolution a repeated origin of new types, now an insect and again a bird—resultants that seem too big for their components. Lloyd Morgan uses the word 'emergence' to emphasise the difference between an additive resultant and an outcome that is a new synthesis.

Without going back to the position of Alfred Russel Wallace, Darwin's magnanimous colleague, that man's higher qualities demand "some origin wholly distinct from that which served to account for his animal characteristics—whether bodily or mental," without seeking for this dualistically in some special 'spiritual influx,' such as operated also at the origin of living creatures and of consciousness, we may see some truth in the idea of man's 'emergence' and apartness. He was an organic genius, a new synthesis, if ever there was one; no mechanical additive resultant, but a vital new creation, though coming but slowly to his own; not involving any breach of continuity, but making a fresh disclosure of the riches of reality—and continuing to do so. Into the fabric of humanity

came many strands of many mammals, but some threads were new and the pattern was new, and it continues to evolve—But this 'emergence,' it may be said, savours of the magical,—an outcome too big for its antecedents! Yet is this not one of the commonest of fallacies? We are not slow to regard man in the light of evolution, but we have scarcely begun to envisage evolution in the light of man.

To return to Sir Arthur Keith's address—it stands out as a discourse instinct with the scientific spirit; it is a fine piece of scientific tactics—to abstain, except once, from speculative discussion of factors, so that the facts might stand forth in their stability; and it is a beautiful piece of English prose, as one knew beforehand it would be, for "Le style, c'est l'homme même"

## Mechanics of the Atom.

The Mechanics of the Atom. By Prof Max Born.

Translated by Dr J W Fisher and revised by Dr D R. Hartree. (International Text-Books of Exact Science.) Pp. xvi+317. (London. G Bell and Sons, Ltd., 1927.) 18s net.

TYTHEN Prof. Born published his "Vorlesungen über Atommechanik" two years ago, atomic theory was beset with difficulties which, as one writer has remarked, were strongly suggestive of the epicycles of Ptolemaic astronomy. It was obvious that there was some inherent defect in the theory and nothing less than a radical change of outlook was required. It seemed impossible to make a quantitative determination of intensities of spectral lines on the basis of accepted mechanical pictures of atoms Nor could the theory of dispersion be considered satisfactory, as it depended on a transcription of the various steps in the ordinary classical theory and was not built up logically on the fundamental postulates of the quantum theory.

The fundamental step in resolving these, among other, difficulties was taken by Heisenberg soon after the appearance of Prof. Born's book. He abandoned the usual methods of calculation in terms of mechanical frequencies and such features of mental pictures as were not amenable to observation; in fact, he virtually abandoned the usual pictures in space and time whereby an electron is here and here only at one instant, and there and there only at the next. He introduced instead a quantum mechanics involving manifolds of quantities—matrices as they were afterwards shown to be—which depended on observable transition frequencies and not on unobservable mechanical (or

orbital) frequencies—The atom must henceforth be considered as a whole and not as a collection of individual particles each with a separate identity. The importance of the new step was immediately recognised and led to a rapid development of a rational, self-contained system of quantum mechanics with a remarkable simplification of the essential quantum conditions.

The theory was only a few months old when a new and independent set of investigations was published by Schrödinger, who introduced another point of view. Schrodinger re-emphasised the analogy between dynamics and geometrical optics, already pointed out by Hamilton in his first researches on dynamics But he went further than Hamilton in that he attempted to extend the analogy between mechanics and optics to take in the concept of waves, which had proved so necessary m optics to explain interference and diffraction phenomena. Schrödinger found the appropriate generalisation of ordinary Hamiltonian dynamics, and, beginning with the simple hydrogen atom, applied it with astonishing success to a number of atomic problems

After the essentially mathematical nature of the matrix mechanics, the new treatment by Schrödinger came as a pleasant relief to many physicists, as it, at any rate, held out some prospect of the re-establishment of physical pictures of atomic processes. Although in this theory material particles are replaced by wave systems, a definite localisation of electric charge in space and time seems possible, and this with the aid of ordinary electrodynamics accounts for the frequencies, intensities, and polarisation of the light emitted by atoms without the introduction of a number of correspondence and selection principles. Furthermore, the theory accounts for the phenomena of absorption, dispersion, and scattering in a more. rational way than was possible with the old quantum theory.

The equivalence of the matrix and wave mechanics has now been established (principally by Schrodinger himself), and attention has latterly been directed to the physical and philosophical implications of these two aspects of atomic theory. The relation between the Schrödinger waves and electrons seems analogous to that between radiation and light quanta. On the wave theory, one cannot answer the question as to how a particular particle moves, but one can instead find the probability of its moving in any specified direction. Whether or not this means the abandonment of the law of causality in atomic problems is a question

which has received considerable attention recently, but is likely to remain for some time unanswered

In the hands of Prof. Born the new theory has vielded a satisfactory explanation of the results of Franck and Hertz on electronic collisions with atoms, and has led to a qualitative explanation of the experiments of Dymond on electron scattering. While incompetent to deal with the life history of any single electron in collision, the new theory deals successfully with a stream of electrons and may be regarded as a singular fusion of mechanics and statistics.

In the light of the new work and the abandoning of cherished mechanical pictures of atomic processes, such terms as position and velocity of electrons require examining anew. Only when methods have been devised for their experimental observation will they be of physical significance. The possibility of making such determinations has recently been considered by Heisenberg, and has led him to important conclusions regarding the possibility of making simultaneous determinations of the position and velocity of a free electron. It seems that here, too, Heisenberg has opened up a new line of thought, and interesting developments may be expected in the near future.

In view of these recent developments in the mechanics of the atom, it may well be asked whether any useful purpose is served by the translation of Prof. Born's book published two years ago. The answer was given by Prof. Born in the preface to the original German text, when he said.

This work is deliberately conceived as an attempt, an experiment, the object of which is to ascertain the limits within which the present principles of atomic and quantum theory are valid and, at the same time, to explore the ways by which we may hope to proceed beyond these boundaries. In order to make this programme clear in the title, I have called the present book 'Vol I', the second volume is to contain a closer approximation to the 'final' mechanics of the atom."

The material for Prof. Born's second volume is now to hand, and students of theoretical physics will await with some impatience the completion of the task which Prof. Born has set himself. Meantime, the first volume serves as an excellent introduction to recent developments. It provides an account, at once concise and lucid, of the general dynamics of Hamilton and Jacobi, with just that special orientation towards atomic problems for which there has been a long-felt want. It introduces the reader to just those theorems of dynamics which have proved so essential in the recent developments of the new quantum mechanics.

The translation has been carried out with great care under the supervision of Prof. Andrade, who has himself contributed one of the most valuable of recent introductory treatises on atomic structure. The book shows signs of a painstaking revision, with the result that the reader is presented with a translation which is accurate without a too slavish adherence to the original text.

There are one or two minor departures from the German text, which have been necessitated by the publication of new experimental work since the appearance of the original edition. Some modifications have been made in the early paragraphs concerning the mechanism of radiation to take into account the experimental results of Geiger and Bothe, and of Compton and Simon, and there has been a modification of the derivation of the Rydberg-Ritz series formula on the lines suggested by Bohr

The publishers are to be congratulated on their enterprise in producing a translation of this book, and on the efficiency with which they have carried out their task. The binding and printing are alike excellent.

J E L-J.

### Cambridge Biographies.

Alumni Cantabrigienses a Biographical List of all known Students, Graduates, and Holders of Office at the University of Cambridge, from the Earliest Times to 1900. Compiled by Dr. John Venn and J. A. Venn Part 1: From the Earliest Times to 1751. Vol. IV.: Saal-Zuinglius. With an Appendix containing additional Information relative to previous volumes. Pp v+538 (Cambridge. At the University Press, 1927.) 150s net

THIS volume completes the monumental record by the late John Venn and his son, of the sons of Cambridge up to the year 1750, it contains 42 pages of additional information in supplement to the earlier volumes. The welcome announcement is made in the preface that the Syndics of the University Press have undertaken to see Part 2 also of "Alumni Cantabrigienses"—for the years since 1750—through the press

There are not so many famous names in science in the present volume as in the earlier ones—we note John Wallys, one of the founders of the Royal Society; Samuel Wegg, its treasurer for thirty-four years, Edward Wright, of Mercator's projection, Francis Willoughby, the distinguished naturalist, fellow traveller with John Ray: William Turner, the scientific pioneer in botany; Robert Smith, founder of the Smith's prizes, Nicholas

Sanderson, who lost his eyesight in infancy from smallpox, yet became later Lucasian professor, and William Whiston, Newton's successor in the same chair, who was banished from the University for his Arian views — We note that T Tudway, organist of King's and professor of music, was deprived of his chair for making puns on the queen, but he afterwards recanted and was readmitted

Robert Taylor, who perfected the cure of ague by quinine and was physician to Charles II, is one of many distinguished medical men who figure in the volume, and it is noteworthy how frequently the letters FRCP, F.RS are coupled together. Another prominent group are the divines, among whom may be mentioned William Tyndal, the translator of the Bible. Archbishop Whitgift, Samuel Wesley, father of John and Charles, and Thomas Sheppard of Emmanuel, in honour of whom Cambridge, Massachusets, was so called. The names of Edmund Spenser, John Suckling, and Edmund Waller remind the reader of the place of Cambridge as a nursery of English poetry, while Laurence Sterne and W. Stukelev recall other literary activities.

Echoes of bygone times are found in the record of Job Tookey, admitted at the age of thirteen years in 1658, removed after a fortnight, apprenticed to a grocer in Cheapside and later sent to sea, or of Henry Sumpter, sent from King's College to New College, Oxford, where he was thrown into a cave under the College where salt fish was kept—and died not long afterwards A more modern touch is sadly supplied by F. Sterling, Fellow of Jesus, killed in the War in Flanders in 1692 of Sir Robert and Horace Walpole; of Thomas Wentworth, Earl of Stafford; and of George Villiers, Duke of Buckingham, recall the historical background; while Richard Whittington, Lord Mayor of London, figures in the volume as one of the early benefactors to the University Cambridge owes a deep debt of gratitude to the authors of these volumes for their zeal, learning, and accuracy, and the services of the University Press in publishing them must not be forgotten.

# The Origin of the Week.

The Week: an Essay on the Origin and Development of the Seven-day Cycle. By F. H. Colson. Pp. viii + 126. (Cambridge: At the University Press, 1926.) 5s. net

THE seven-days week is a division of time which has long been in general use, and is commonly believed to have come down to us from

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at least the time of Moses, but why or how the days have become associated with the planets—the word planet is here used as understood by the ancients—is not so generally known. Mr Colson's book supplies an immense deal of information on this point, and is obviously the result of a great deal of study and research

The author's purpose is to show that our present week is a combination, which took place within the Roman Empire, of two distinct systems—the Jewish week and the 'planetary' week The former had long been familiar to the Romans, but the latter, as he shows, cannot be traced back much earlier than the beginning of the Christian era, and was due to the development among the masses of astrological ideas as to the influences of the planets.

The accepted order of the planets according to their distances from the earth, starting with the outermost, was Saturn, Jupiter, Mars, Sun, Venus, Mercury, and Moon, but this order is not at first sight evident in the sequence of the names There are successive jumps over two planets, but a suggestion of Dion Cassius is accepted as probably correct, namely, that the planets were supposed to rule successively for one hour at a time. Thus starting with the first hour of Saturn's day (Satur day) Saturn itself was regent, but Jupiter presided over the second hour, Mars over the third, and so forth, which brings the first hour of the second day under the regency of the sun (Sunday). Similarly, the opening hour of the third day will be ruled by the moon (Monday), and the order of the names throughout the week is thus readily explained It is suggested that originally the point of contact between the Jewish and the planetary weeks was the Sabbath. It is shown that by the beginning of our era the idea had become widespread that that day was Saturn'sday, and this may perhaps have given the planetary week its starting point

Among other matters of interest in the book we find the discussion of such subjects as the week in the New Testament and the early Church, and the establishment of Sunday as the Lord's Day. With reference to the latter, while acknowledging that by the second century the first day of the week had acquired an undoubted sanctity as that on which the Resurrection took place, the author concludes that we owe our religious and civil Sunday to the combination of two factors, namely, "the immemorial familiarity of the Jewish Christian with the Sabbatical week, and the recent familiarity of the Gentile Christian with the

planetary week" There is also an instructive one and all excellent. The description of bonito chapter on the week in northern Europe, and the names of the days in various European languages are collected together into five groups in the appendix.

The book is extremely well written and contains much information not readily accessible to the ordinary reader Its usefulness would have been still further enhanced by the addition of an index or a synopsis of the chapters.

### Our Bookshelf.

Treatise on Sedimentation. Prepared under the Auspices of the Committee on Sedimentation, Division of Geology and Geography, National Research Council of the National Academy of Sciences By William H Twenhofel and Collaborators. Pp xxv + 661 + 38 plates. (Baltimore, Md. Williams and Wilkins Co. London: Baillière, Tindall, and Cox, 1926.) 34s net.

The treatise is a bold and ambitious attempt to present a comprehensive statement of our present knowledge of sediments and the processes which control their formation and development From the point of view of work accomplished in America, it may be satisfactory as a preliminary basis for the discussion of future researches, but it is unfortunate that many British and European contributions to the subject matter should have been overlooked. The committee on sedimentation has apparently realised this source of weakness in their earlier work, for Prof L W. Collet has now been added as a European representative. In the treatise itself the lack of international proportion is shown by the fact that there is only one nominal reference to the far-reaching work of Prof P G H. Boswell, and that to the statement that "sand is predominantly composed of quartz grains." On p 629 one of Boswell's memorrs is wrongly attributed to Crook, but in compensation Crook's name does not appear in the index.

While it is in many parts admirable, the treatise is clearly far from being the authoritative work we might reasonably have expected. The necessity for further studies of environment of deposition and of diagenesis is revealed by the striking absence of precise knowledge in these fields of geological endeavour.

 $\begin{array}{lll} \textit{Melanesians of the South-east Solomon Islands}. & \text{By} \\ \text{Dr. W. G. Ivens.} & \text{Pp. } \sin + 529 + 15 \text{ plates.} \\ \text{(London: Kegan Paul and Co, Ltd., 1927.)} \end{array}$ 30s. net.

This book is very well written, in simple vivid language, and the author is at his best in the descriptions of particular customs, ceremonies, and beliefs. The chapters on sexual life, betrothal, and marriage, the accounts of fishing and gardening, of feasts and dancing, of warfare and magic, are

fishing, so characteristic of the Southern Solomons, is of outstanding literary merit and scientific interest

The abstract subjects, such as kinship and legal or economic organisation, suffer from a weak grasp of sociological principles. The table of kinship nomenclature is well-nigh worthless, in that it gives the native words for English appellations mstead of giving a sociological analysis of the native terms. The author is right in correcting the late Dr Rivers (on p 59) on the use of personal names between relatives in some parts of Melanesia, a custom which is by no means confined to Dr. Ivens's area But when he adds that "relationship terms in these places (Sa'a and Ulawa) do not connote social duties," he contradicts his own evidence, and his mistake is due to an obvious misunderstanding of Dr Rivers's words and ideas. Equally misleading are certain generalisations about native shell money

On the whole, however, the book is a valuable contribution to Melanesian anthropology: it provides very attractive reading, and is magnificently filled with illustrations in colour and black and white, with diagrams and

Practical Psychology: Human Nature in Everyday Life. By Prof Edward Stevens Robinson. Pp xii + 479. (New York: The Macmillan Co., 1926.) 7s 6d.

This is a simple presentation of the main features of psychological science aimed at bringing out the relations of its principles to the personal life of the student. As the study of human nature, psychology deals with human behaviour as well as with mental life in the abstract; and, for practical purposes, a knowledge of behaviour and its sources is the more important aspect of the two. Though most people know some psychology (since they carry human nature about with them and can scarcely fail to observe it), science is necessary to approve, correct, or reject popular notions as to the working of human nature, especially when such notions are employed in any attempt to alter or perfect its working. Chapters on the connexion between human nature and body are followed by a fairly complete discussion of all the topics dealt with in elementary psychological textbooks.

The matter is clearly presented, with simple problems suggested at the end of each chapter and references for further study appended The book substantiates its claim to be practical throughout, and needs no educational background "greater than is likely to be possessed by a student in the latter part of the high school course." As an indication of the general method followed by the author, one of the problems set at the end of the chapter on personality may be quoted. "No personality is perfect. What steps might you take to make yourself a more effective individual  $^{\imath}$  " Materials for its solution, as for that of the other problems set, are given in the text.

Faune de France 13 Deptères (Brachycères)

(Stratiomyridæ, Erennidæ, Conomyridæ, Rhagronidæ Tabanidæ, Codidæ, Nemestrinidæ,

Mydaidæ, Bombylidæ, Therevidæ, Omphralidæ)

Par E. Séguy Pp 111 + 308 55 francs 14

Deptères pupipares Par Dr L Falcoz Pp 64

12 50 francs (Fédération française des sociétés
de sciences naturelles Office centrale de faunistique) (Paris Paul Lechevalier, 1926)

We welcome these two additions to that excellent series the 'Faune de France' Part 13, by M  $\to$ Séguy, deals with all the families of the so-called Platygenia group of the Brachycera with the exception of the Asilidæ This family, along with the Orthogenia, will presumably form the substance of a future volume Part 14, by M L Falcoz, is concerned with the group Pupipara, and we are glad to note that the Braulidæ are no longer included among the latter These treatises are more especially intended as guides to the identification of the groups concerned, and for this purpose concise family, generic, and specific keys are provided. Further and more detailed characters will be found under each species together with a summary of its geographical range Special mention needs to be made of the very large number of line figures illustrating important diagnostic features The biology of these insects is also by no means neglected, and, wherever information exists, some account of larval and pupal structure and habits is given. These two parts are well up to the standard of their predecessors, already noticed in these columns, and they can be recommended to all dipterists as well as to the general entomologist.

Aeronautical Meteorology. By Wilhs Ray Gregg. (Ronald Aeronautic Library) Pp. xii+144+11 plates. (New York The Ronald Press Co, n d.) 2.50 dollars

The aeronaut's need of a knowledge of weather is vital, but the ordinary meteorologist when trying to provide for it finds it difficult to put on one side the conventional modes of treatment and to remember what is really wanted. thus when describing the upper winds at any place, he is tempted to give the mean wind direction at successive heights, instead of a table of the relative frequencies so that the pilot may know the likelihood of a favourable wind.

However, Mr. Gregg has admirably realised the situation. After an account of the general circulation and of the methods of observation, he naturally deals with American conditions, discussing the vertical structure of the air (but the constancy of e P on p. 31 should be explained), the change of winds with height and gustiness, fogs and clouds (the photographs of these being excellent), visibility, thunderstorms, cyclones and anticyclones, forecasting, and flying over the North Atlantic and the north polar regions. His moving thunderstorm' corresponds with what is called in England a line squall, but its width is given as 40 to 50 miles, the length being 150 to 200 miles. The chapter on cyclones is essentially practical, though interesting theoretical questions

are raised by the predominance of rain to the N.W. of the centre instead of to the S.W. and S.E., which the Bjerknes theory suggests. We wish that such a book were available for those under British conditions.

Field Astronomy: for Engineers and Surveyors
By Prof D Clark Pp viii + 164 (London
Constable and Co., Ltd., 1926.) 10s 6d net

This manual provides a concise summary of the astronomical principles and methods of observations employed by surveyors and engineers when requiring absolute positions on the earth's surface in the course of survey work The contents are lucidly arranged in three chapters, dealing respectively with principles, instruments, and observations Good type, explanatory diagrams, reproductions of the various instruments used, a number of worked examples, and a bibliography contribute materially to the value of the book. The description of the methods for determining longitude includes full details of the reception of radio signals used for this purpose. Consonant with its title, the book is of handy pocket size. It should be of great use both to engineers, who wish to have the working details of astronomical observations used in the field, and to university students of surveying and geodesy

A Handbook of Renal Surgery By F McG Loughnane. Pp xiv + 210 (London Longmans, Green and Co , Ltd , 1926 ) 10s. 6d net

In his preface to this book, Mr Loughnane tells us that it is intended for the use of general practitioners and students The reader will therefore not expect detailed descriptions of kidney operations, which are largely in the hands of specialists The author concerns himself almost entirely with the investigation of surgical diseases of the kidney, and his accounts of diagnostic methods are clear and complete The number and quality of the radiographs with which the book is illustrated demonstrate the value of X-rays in this branch of surgery, and it is evident that there are few surgical conditions of the kidney which do not require preliminary radiological investigation. There is a useful chapter on the estimation of renal function

Chambers's Encyclopædia a Dictionary of Universal Knowledge Edited by Dr David Patrick and William Geddie New edition Vol 9 Sacrament to Teignmouth. Pp 1v + 904. (London and Edinburgh: W and R Chambers, Ltd.; Philadelphia J. B Lippincott Co, 1927) 20s. net.

This useful encyclopædia is now nearing completion. The present volume contains a number of new articles, while the others have been thoroughly revised. Several of the articles are of considerable length and give practically all the information about their respective subjects that the reader or student could desire. The free use of illustrations and diagrams adds to the value of the work. All the longer articles have numerous references to literature. There are eight coloured maps by Bartholomew with new boundaries clearly shown.

### Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can be undertake to return, not to correspond with the ariters of rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

# An Effect of Sunlight on the Altitude of Aurora Rays.

ON Sept 8, 1926 between 21° 30° and 22°, Greenwich mean time, I saw from Bygdo, near Oslo, a remarkable aurora in the west. It had the form of a portion of a feeble arc of grey violet colour, stretching upwards from the horizon about 40°. Later on this arc changed into a diffuse mass sharply limited on its south border.

Simultaneously, this aurora was very carefully observed from the Lerwick observatory as faint streamers on the northern, eastern, and western part of the sky up to zenith

I was fortunate enough to have two of my aurora stations in action. Bygdo and Oscarsborg, mutual distance about 26 kilometres, and I obtained of this remarkable aurora a series of photograms of the greatest interest. The measurement and calculation of the photographic plates will appear shortly in Gerlands Bertrage zur Geophysik and I will here only mention the principal results.

The arc appeared on the plates as a curtain of rays which were difficult to distinguish visually, and this curtain was situated over and to the north-west of the Shetland Islands at the quite unusual height of 300 to 500 kilometres. The diffuse form which ended the aurora display probably reached the immense height of more than 1000 kilometres. This high curtain was essentially different from all curtains measured in southem Norway from 1911-1922, m fact, these curtains generally had a vellow-green colour and were situated from 80 to 200 kilometres above the earth.

The situation of the cuitain fai in the west, some hours after sunset, led me to the supposition that it was perhaps illuminated by the rays of the sun My assistant. Ragnyald Wesoe, made at my request the necessary calculations, and the hypothesis was verified the amora

was situated in that portion of the upper atmosphere directly illuminated by the sun.

It was now an interesting question to know if the aurora rays, measured during the years 1911 to 1922 and of unusual altitude from 400 to 800 kilometres, were also exposed to the rays of the sun. Mr. Wesoe calculated the height of the daik portion of the atmosphere for each ray whose situation had been calculated from photograms <sup>1</sup> and the results are as follows.

The rays situated in the interval from 400 to 800

kilometres above the earth were all exposed to the sum's rays, and of those stretching from 100 to 400 kilometres, about 95 per cent were in darkness. This remarkable fact is most clearly seen in Fig. 1 which gives the situation of all the aurora rays from 20° 21°, Greenwich mean time, on Mar. 22, to 2° 53° on the following day. Each ray is marked by a vertical line, and an arrow indicates that the lowest or highest point of the rays were outside the photographic field. The boundary between the dark and sunlit atmosphere is marked by a short stroke the height of which is the mean between the heights corresponding to the highest and lowest measured point of the ray. In this first approximation no account has been taken of refraction.

From this diagram it is clearly seen that the height of the rays is great in the evening and in the morning, but low during the night. The high rays in the

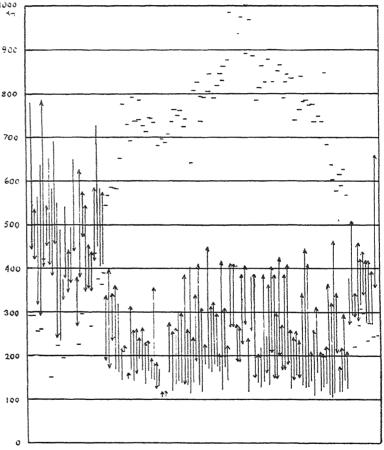


Fig 1

morning of Mar. 23 were of a beautiful blue colour, and through a small pocket spectroscope I saw a quantity of lines in the blue and violet, while the common green aurora line was rather faint. I am sorry that I had used all the plates on the other stations, so that only a very few photograms of these blue rays were taken. But judging from single photographs, the rays later reached heights probably exceeding 800 kilometres.

It seems from these facts that the sunlight has a remarkable action on the upper atmosphere, so that the illumination caused by the electric rays forming the aurora borealis became visible to much greater altitudes than ordinarily.

<sup>&</sup>lt;sup>1</sup> See "Resultats des mesures photogrammétriques des aurores boreales observées dans la Norvege meridunale de 1911 a 1922," Fig. 12, Geofysiske publikationer, vol. 4. No. 7, Oslo, 1926.

It is well known from wireless telegraphy that simhight ionises very strongly the higher atmosphere, and it may be that the accumulated ionising effect of the sunlight and of the electric rays illuminates the atmosphere to a greater altitude than the electric rays alone. Perhaps also the ionisation lifts up the atmosphere by electric charge, as in Vegard's theory, or perhaps such a hiting up may be the effect of a raising of the temperature in those regions. A detailed study of photographs of the spectra of these high rays may solve the question as to the cause of this effect of similable on the altitude of the aurora.

Carl Stromer.

Oslo, Norway

# The Existence of more than one Ionised Layer in the Upper Atmosphere.

During the past year and a half systematic observations have been made at this station on the characteristics of wireless waves deviated by the upper atmosphere. These observations, which have been made as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research, were begun in collaboration with Mr. M. A. F. Barnett and have more recently been continued with Mr. J. A. Ratcliffe's assistance.

As part of such routine measurements many determinations of the equivalent height of the Kennelly-Heaviside layer have been made, utilising special transmissions from the National Physical Laboratory and from the stations of the British Broadcasting Company. The early summer observations of 1926 showed that the night-time height of this deviating layer, for wave-lengths of 400 metres, was usually 90 km to 130 km. During the period October 1926 – May 1927, however, heights of an entirely different order of magnitude, namely, 250 km. to 350 km., have been frequently measured during the three hours before dawn. On such occasions, after the high values have been recorded for two or three hours, a discontinuity in the series of values occurs 30 to 40 minutes before sumise, and heights of the normal value are again recorded.

The experimental evidence, the detailed discussion of which will appear shortly, leaves little doubt that on such occasions, in the period before dawn, the ionisation in the Kennelly-Heaviside layer has been sufficiently reduced by recombination to permit of its penetration by waves of this frequency. Reflection, however, takes place at an upper layer which is richer in ionisation. With the advent of sumrise at a height of 100 km. or so, the Kennelly-Heaviside layer is formed again and deviation by the lower layer is suddenly established, the normal fall of the under boundary of the latter proceeding afterwards as the more direct solar influence increases the region ionised. As the day further proceeds, the experimental results suggest that another region of ionisation is formed below the Kennelly-Heaviside layer, which, while causing attenuation of the waves, does not very materially affect the height at which they are deviated.

The obvious bearing of these results on the nature of the solar radiation responsible for atmospheric ionisation and their correlation with the results of terrestrial magnetism must await a more detailed discussion. There is, however, one small point which may be mentioned here. It seems of interest in indicating the possibility that simultaneous observations between the same two stations on widely different wave-lengths might enable us to study the characteristics of both layers at the same time. Since ultrashort waves require a greater electron concentration to deflect them back than do the longer waves, there may not be enough electrons in the Kennelly-Heaviside

layer to send back the former, so that for angles of incidence less than a certain amount (e.g. in short distance transmission), such wave-lengths would be deviated by the upper layer at all times of the day The relatively large amplitude of the ray returned from the upper layer in the experiments mentioned above, in which 400 metre waves were used, demonstrates the low attenuation consequent on deviation at such great heights, so that with ultra-short waves the greater part of the absorption would probably take place in the penetration of the lower layer. Thus, even for transmission over long distances, we might expect a higher ray path, and deviation at the upper layer would result in less resultant absorption than a low ray path with deviation at the Kennelly-Heaviside layer It may be mentioned in this connexion that the American determinations of the height at which these ultra-short waves are 'reflected' fit in with the above ideas of their deviation at the upper layer

Radio Research Station,

Dogsthorpe, Peterborough.

### Barrier Reefs of Tahiti and Moorea.

The surprising fact that fragments of volcanic lock occur in the barrier reef of Tahiti, as reported by Dr. Crossland in Nature for April 23, must be welcomed by all students of that remarkable structure, but that fact does not, it seems to me, prove the "original continuity of the present barrier reef from the [Island] shore to the ocean slope" outside the reef, as is stated in his second letter in the issue of July 2 The fact only permits the inference that the lagoon was formerly filled in some manner, perhaps by stream deltas instead of by a broadened fringing reef, so that island detritus could be transported to where the barrier now stands ference involves so extraordinary a series of changes from former lagoon filling to later lagoon excavation -for which there is no other satisfying evidence provided—that even the inference should not be accepted as valid until all other possible means of explaining the occurrence of the volcanic fragments have been excluded Further details as to the nature of the fragments and the manner of their occurrence are desirable

Dr. Crossland's rejection of the physiographic evidence for the subsidence of Tahiti, as provided by drowned-valley bays and as given in my account of the island (Annales de Géographie, 27, 241-284, 1918), seems to me of a piece with the neglect of such evidence on the part of Murray, Guppy, A. Agassiz, and other students of coral reefs, and that neglect was clearly the result of their unfamiliarity with physiographic evidence rather than of its weakness. Regarding the occurrence of embayed valleys, my observations in 1914 led me to be just as positive in asserting their presence near the isthmus which connects the two cones of the Tahiti doublet as Dr. Crossland is in asserting that "There are no bays in Tahiti." The bays to which I refer are "little bays which," as Dr. Crossland says, "open out of Port Phæton," and masmuch as they enter well back of the general shore line of the island between eroded slopes of volcanic rock, I took them to be the partly drowned valleys of ordinary streams, and so still regard them, in spite of their being described as "peculiar" by Dr. Crossland and as "certainly not drowned valleys." But I fully agree that Port Phæton Bay is merely a re-entrant space between the two confluent volcanoes of which Tahiti is composed. This origin was by no means overlooked in my article, for I there said that Port Phæton Bay on the southwest side of the inter-cone isthmus and the corresponding Taravao Bay on the north-east side of it

"sont évidemment en rapport avec la forme mitiale des deux cônes contigus" (p. 245)
When the small bays which open out of Port Phæton were produced by the entrance of sea water into their little valleys in consequence of a moderate subsidence of the island, all the many larger valleys of the island were presumably embayed also, but they have all been filled with alluvium, because the drainage areas tributary to them are larger and more The small bays, which still remain mountainous but partly filled, appear to have escaped complete filling because they receive streams from small drainage areas. Of course the many bay-filling deltas have a seaward slope. Indeed, the associated facts that the delta flats are in no case level and that their streams have a rapid flow along them, both of which Dr Crossland mentions as if to discredit the origin of the flats as the fillings of former bays, have no such bearing

On the other hand, a number of the delta flats are a quarter or half mile wide at their mouths; and that so great a width should there be given them by the lateral erosion of their streams, while the streams still flow in sharp-cut V-valleys upstream from the flats, seems to me unreasonable. The more reasonable explanation of the flats is, as above stated, that they are the fillings of valleys that were embayed by island subsidence; and this explanation is all the more reasonable in view of the absence of a shallow rock platform in front of the great cliffs in which the inter-valley spurs have been cut back by former wave action around most of the island circumference

I am glad that Dr Crossland has recognised these old manne cliffs, for they have generally been overlooked by earlier observers, excepting Agassiz: indeed, at least two observers have explicitly stated that there are no sea cliffs at the base of the island slopes Surely, a rock platform must have slanted gently seaward just below sea-level when the cliffs were cut back by the ocean waves during a reefless period in the earlier history of the island; the absence of reefs at that time being presumably due to the abundant outwash of detritus from the nonsubmerged valley mouths, as is to-day the case in the reefless island of Reunion. But instead of being now fronted by such a platform, the cliffs of Tahiti are fronted by a lagoon twenty or more fathoms in depth, even though the lagoon floor has been aggraded by an unknown measure of detrital deposits derived from the island and the reef. Evidently, therefore, the cliff-base platform has subsided to a greater depth than that at which it was originally cut, and this subsidence must have been the same as that which produced the now delta-filled valley embayments. The cliffs as at present seen must plunge below sea-level

As to my interpretation of the slopes of white sand inside of the Tahiti barrier reef as evidence of inwash from the reef, and as therefore contradicting the idea that the lagoon is now suffering excavation, I am by no means persuaded that it is erroneous. Agassiz' account of his dredgings in the lagoon lead to the same conclusion, for its floor contains much detritus from the island. If other parts of the inner slope of the barrier reef than those which I saw are devoid of inwashed sand, that may perhaps be because the reef is there broader, or because the sand has been shifted by lagoon waves down the slope from the reef to the middle depths of the lagoon floor. But regarding this point, as well as the blocks of coral rock on the sand slopes, I will wait for the appearance of Dr Crossland's fuller report, which I will examine with the same interest that I hope he

will give to my book on "The Coral Reef Problem," shortly to be published by the American Geographical Society of New York. He will there find many details concerning my observations on numerous Pacific reefs, the present lack of which he is good enough to regret In the meantime I may reter him to a rather lengthy article on the coast and reefs of New Caledonia in the Annales de Géographie for 1925, and also to a small book on the Lesser Antilles, with particular regard to their imperfect barrier reefs, published by the American Geographical Society in 1925 But the details that I give are chiefly physiographical rather than biological That side of the problem I am not prepared to deal with; and in any case it seems to me the less significant side, so far as reef origins are concerned, for it is to the forms and the changes of the island coasts, as determined by abrasion, erosion, and movements of upheaval or subsidence, that the reef-builders must adapt themselves.

Dr. Crossland is fully warranted in saying, so far as my published articles show, that I seem "to have missed the cliffs ' on the north side of Moorea, a smaller island than Tahiti, not far north-west from it, for in my Tahiti article it is unfortunately asserted that "aucune falaise n'entaille les contreforts" of the smaller island (p. 277). Nevertheless I saw and sketched the north-coast cliffs of Moorea, as will appear in my forthcoming book, and I have even ventured to explain their local occurrence as the consequence of a prolonged attack by the sea on the north coast after the subsidence of the island had begun, because the two largest valleys of Moorea open on that side, and the abundant detritus that they have discharged must have drifted westward from the valley mouths and formed a beach along the shore, thus preventing reef growth and permitting continued cliff cutting there, although, in consequence of sub-sidence, reefs had then already been formed by upgrowth around the rest of the shore line and protected it from abrasion It is because of this subsidence that the lower cliffs, which were presumably cut all around the island in its unprotected youth, are no longer visible. Cliffs are seen to-day only on the north side where, as above suggested, the continuation of abrasion after subsidence had begun gave the cliffs a greater height than elsewhere This explanation is rather venturesome, but it is better than none.

In view of my failure to mention the north-coast cliffs of Moorea, Dr. Crossland concludes that my "criticism of Daly's theory of glacial control . . . fails in this case." By no means: but I must leave that long story for more deliberate presentation elsewhere. Suffice it to say now that the absence of cliffs from most of Moorea and from many other reefencircled islands in the true coral seas of the Pacific not only contradicts the glacial-control theory, but also goes far toward proving that the partly sub-merged cliffs of Tahiti were not cut back by low-level abrasion in the glacial period. It is only in the marginal belts of the coral seas that cliffs due to lowlevel abrasion are to be found, as I have shown in the above-cited booklet on the Lesser Antilles and elsewhere. In conclusion, let me add that I accept Dr. Crossland's dictum that "barrier reefs can no longer be taken as an index of subsidence without independent proof from the adjacent land;" and it is precisely because such independent proof is almost universally forthcoming that the upgrowth of barrier reefs as a consequence of island subsidence may be generally accepted, essentially as Darwin long ago W. M. DAVIS. inferred.

Harvard University, July 21.

 $^1$  "The Marginal Belts of the Coral Seas," Proc Nat. Acad. Sci., 9, 292-296 , 1923 , also Amer Jour. Sci., 6, 181-195 , 1923

### Surface Layers on Tungsten produced by Active Nitrogen.

WE have found that a fine tungsten filament at a very dull-red temperature placed in a stream of nitiogen undergoes a considerable (10-25 per cent ) lowering of its resistance (for constant current flowing through it) when active nitrogen produced up-stream At the by a condensed discharge passes over it same time the colour changes to a much duller red, that is, the radiation is decreased. These changes persist until the filament is momentarily flashed at a white heat, whereupon the original condition is regained. Apparently a surface layer of some soit forms on the filament and produces a lowering of its temperature. The resistance of the filament at 100m temperature is the same either with or without the

The same cooling effect can be produced by bombarding still nitrogen with electrons from another source filament accelerated by suitable electric fields. In a tube with large nickel electrodes which had been thoroughly degassed by the repeated use of an induction furnace, this effect was first detectable when the exciting electrons had an energy of 11 volts. The rate of formation of the layer increased rapidly with the voltage. In a second tube, in which the anode was a hot tungsten spiral, the effect was not detectable below 22 volts. The effect was independent of the potential of the testing filament, showing it to be produced by a neutral substance. It seems possible that in the first case the active substance was produced at the low voltage by bombardment of the metal surfaces. These effects were obtained both with commercial nitrogen which had been passed over hot copper and with nitrogen prepared by Waran's method which was so pure that it would not give the afterglow.

Peculiar current-voltage characteristics were obtained with the tube having the hot anode. With increasing voltage the current increased, as in other gases, up to 22 volts, at which voltage it began to fall off At 25 volts an arc struck, the current took a sudden rise immediately, followed by a decrease in two or three seconds to a value considerably below that which it had had before the arc struck. Further mcreases in voltage produced slight increases in current. Upon decreasing the voltage, the current dropped off until the arc broke at about 20 volts. Here there was a sudden decrease in current followed by a slower rise to a much higher current, the same as that at the corresponding voltage before the arc had struck. The two currents were the same for lower voltages. That these effects are characteristic of nitrogen and not ascribable to charges on the walls of the tube seems probable, for no such effects were observed with argon in the tube. A decrease of the thermionic current in nitrogen at much lower pressures and lugher voltages was observed by Langmuir (Phys. Rev., 2, p. 450; 1913). We also observed a considerable temporary decrease in the thermionic emission from a tungsten filament as ordinary active nitrogen passed over it.

A tube was constructed having a pile of tungsten foil discs, spaced apart, and mounted so that they could be flashed with the induction furnace. Electrodes and filaments were provided, so that the nitrogen could be activated either by the disruptive discharge or by electron bombardment of known voltage. Gas pressures were measured with a hot wire guage of small volume. The total volume of the tube and gauge was small enough in relation to the area of tungsten that a gas layer one atom deep on the latter, if evaporated, would cause a pressure of the order of 0·1 mm. The tube was baked out under

exhaust, as usual, at 450° C and the discs well degassed by flashing With a few tenths of a millimetre of nitrogen in the tube, and keeping the discs at a dull-red heat while the spark discharge was passed, a partial clean-up of the gas was obtained exhausting the remaining gas and closing off the pump, the discs were flashed, with the discovery of a considerable quantity of gas Gas so recovered was not cleaned up by a hot tungsten filament, and on examination with a hand spectroscope gave all evidences of being nitrogen The experiment was repeated a large number of times, varying the time of the spark discharge. In all cases except where the time of discharge had been very short, the amount of gas recovered on flashing was a constant quantity, approximately that to be expected from a layer one atom deep Exactly the same results were obtained by activating the nitiogen with an arc at 25 volts At 15 volts there was no indication of clean up, or of a gas layer on the tungsten which could be removed by flashing

Our conclusions are that a clean tungsten surface at a dull-red heat, if placed in an atmosphere of nitrogen, activated either by a condensed discharge or by an electron bombardment at more than 22 volts, becomes covered with a nitrogen layer of the order of one atom The effect of this layer, at this comparatively low temperature, is to cool the surface. It seems probable that it does this by allowing the surface to conduct more heat to the gas, ie by increasing the accommodation coefficient. At relatively high temperatures, the same layer is probably so unstable that only a small fraction of the surface can be covered at any one time, but it acts to increase the work function The flashing of a filament covered with such a layer in the neighbourhood of a clean filament causes the production of a layer upon the latter Apparently the layer evaporated by flashing comes off in an active form. These experiments suggest that active nitrogen can be produced by bombard-inent of nitrogen gas with 22 volt electrons, but further work is necessary to establish this conclusion. The experiments are being extended and completed, and will be described in detail later.

Carl Kenty Louis A. Turnfr

Palmer Physical Laboratory. Princeton University, Princeton, New Jersey, U.S.A.

### The Temperature Variation of the Elasticity of Rochelle Salt.

Valasek ( $Phys.\ Rer$ , 478, 1922) has studied the temperature variation of the piezo-electric modulus of Rochelle salt. He tound abrupt change m the values of this modulus at temperatures of -15°C. and 23°C. using crystal slabs with their length at  $45^{\circ}$  with the  $\bar{b}$  and c crystallographic axes In a later paper he describes experiments undertaken to investigate the temperature variation of other physical properties of the crystal, but these experiments do not indicate discontinuities such as occurred in the case of the piezo-modulus

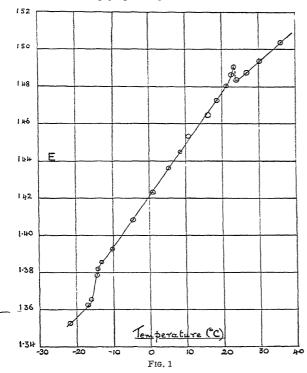
The object of this note is to point out that there is evidence for the existence of similar discontinuities in the values of the elastic constants of this crystal at

these two temperatures

Slabs of Rochelle salt have been cut and mounted so as to form piezo-resonators, similar to the quartz piezo-resonators used in modern wireless practice As shown by Cady and by Dye, these piezo-resonators possess a well-defined resonant frequency, which depends on the dimensions, the density, and the Young's modulus of the crystal. Hence, by investigation of the resonant frequency at different temperatures, it is possible to deduce the temperature variation of Young's modulus for the crystal

Such an investigation has recently been carried out in this laboratory, using a method due to Cady (Proc. Inst. Radio Engrs.. 10, 83; 1922). By using a calibrated wavemeter of the resonant circuit type, resonant frequencies could be determined to within less than 1 part in 5000

The following graph (Fig. 1) shows the variation of



the extension modulus in a direction at 45° to the b and c crystallographic axes, between -23°C, and 36° C. The ordinates represent a quantity, E, which is proportional to the extension modulus; the extension modulus is the reciprocal of Young's modulus. It will be seen that there are two distinct breaks in the curve, one in the neighbourhood of - 15°C and the other in the neighbourhood of 23°C. Similar results have been obtained with crystals cut in other directions.

A full account of these experiments is in course of preparation and will be published elsewhere shortly. R. Morgan Davies.

Physics Department, University College of Wales, Aberystwyth. July 29.

### Newtonian Time Essential to Astromony: A Correction.

In the supplement to NATURE of April 9, I was permitted to discourse on the necessity, after Newton, of a universal time for astronomical science, and had identified it objectively and everywhere with the intrinsic vibrational times of the material atoms. In the last section it was imagined that this course had eliminated what had been considered to be a formidable discrepancy in the verification of the relativity scheme for gravitation.

It is now to be confessed without further delay that this is not so. The reason is, briefly, that it is

only the changes of time-epoch in the observer's own frame that can be neglected, which makes dT/dtequal to  $e^{-1}$  instead of  $e^{1}$ . This change conforms with the discussions, when duly amended, of variable electric mertia, and of the influences of gravitation on the paths of rays and on the spectrum But it seems to make hav of any gravitational Action function of the type naturally assumed, namely,  $\Sigma |_{m_s} cds_s$  with adoption of the usual form for  $ds^2$ , and also equally of the Einstein postulate that each orbit is separately a geodesic on its own account

It appears that one has to conclude that another invariant form must be found for the Action function, or else if that be not feasible, that this type of relativity scheme stands in essential contradiction with the spectro-copic postulate of absolute time for the atoms, as measured in their own frames, and unaffected by accelerations of their motions.

JOSEPH LARMOR.

Portrush, Aug. 18.

### On the Structure of the Spectra of Krypton and Xenon.

As absorption measurements proved to be the key to a complete analysis of the arc spectra of neon and argon, we recently extended the use of the method to include an investigation of the spectra of krypton and

As in the case of neon and argon, we found that some lines in the spectrum of krypton were powerfully absorbed by this same gas when a weak electrical discharge was passed through it With xenon similarly stimulated, selective absorption of spectral lines was also observed Even a casual glance at photographic spectrum plates obtained with both gases showed this weakening of selected lines. As was to be expected, lines in the visible spectral region were scarcely, if at all, absorbed.

Examples of spectral lines, showing strong absorption by the method indicated, are, in the case of krypton,  $\lambda\lambda7601$ . 7854, 8104, 8112, and in the case of xenon,  $\lambda\lambda8231$ . 8819. The degree of absorption that took place in the case of other spectral lines is being determined from microphotometric observations.

In our analysis of the spectrum of xenon, the wavenumber difference 9140 was observed between pairs of wave-lengths with the following frequencies

| 11167, | 11977, | 12675, | 13655, | 13664, | 15371, | 20307, | 21117, | 21815, | 22795, | 22804, | 24511, 116177, 116181, 117552. (25317, (25321, (26692.

The wave-number difference 9140 is the same as that between the wave numbers of the resonance lines λλ1469 9 and 1295 8 found by Hertz. The pairs of lines are therefore  $S_2p_i$  and  $S_1p_i$  (i=1 to 10) lines expressed in the old notation originally used with The infra red wave-lengths  $S_3p_1$  and  $S_5p_1$ involve a metastable state, but wave-lengths showing strong absorption are found among them.

The results given above go to show that the structure of the spectra of the heavier rare gases krypton and xenon corresponds to that of the spectra of the lighter ones neon and argon, namely, a  $S_0$  normal state, a  ${}^3P_{012}$  state comprising 2 metastable sub-levels, a  $P_1$  state, etc. There is, of course, a much larger separation between the  ${}^{3}P_{012}$  and  ${}^{\prime}P_{1}$  levels with krypton and with xenon than with either argon or neon.

J. C. McLennan.

RICHARD RUEDY.

The Physical Laboratory, University of Toronto, Aug. 11.

# Canadian Hydro-Electric Power Development.

By Dr. Brysson Cunningham.

II

IN a review of last year's activities in water-power development by provinces, Quebec took a pronounced lead with 168,000 h p, followed by British Columbia with 48,000 h p, Manitoba with 43,200 h.p.. Ontario with 5700 h.p.; New Brunswick with 2600 h p, and Nova Scotia with a small amount. Dealing first with Quebec, it is to be

the river of that name, flowing into the Ottawa River, is associated with the Canadian International Paper Company, which has pulp and paper mills in the district, while a large quantity of power will be diverted to the Niagara system of the Ontario Hydro-Electric Power Commission.

The writer did not have an opportunity of inspecting the power stations in this district, but

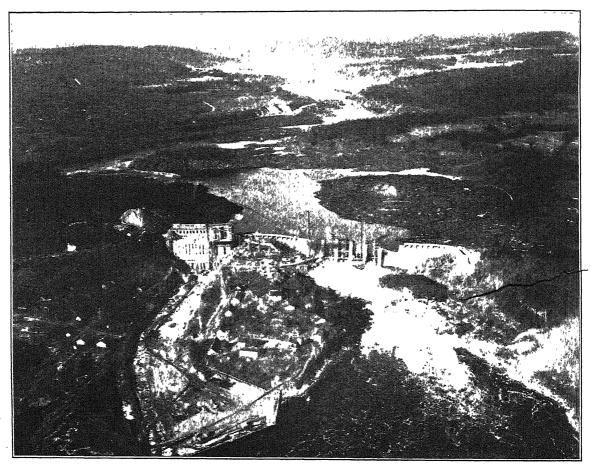


Fig. 2.—Chelsea Falls development of the Gatineau Power Company, Gatineau River, Quebec. Capacity, 170,000 H.P. Under construction, 1926. This plant has recently been completed Reproduced by permission of the High Commissioner for Canada in London

noted that though the plant actually placed in operation during 1926 fell short of the record year of 1925, projects now in course of construction represent a future addition of more than 1,400,000 h.p., which indicates a continuance of substantial progress. The outstanding event of the year was undoubtedly the virtual completion by the Gatineau Power Company of two installations on the Gatineau River at Chelsea and Farmers' Rapids and the initiation of constructional operations at Paugan Falls, the three sites having a total estimated capacity of 530,000 h.p. The Gatineau Power Company, which operates in the valley of

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he had the privilege of going through the two power stations of the Shawinigan Water and Power Co. at Shawinigan Falls in the St. Maurice River Valley, a group of the most important hydroelectric installations in the province, and he can testify with appreciation to the very complete and efficient service of generating and distributing plant which he found in operation. Since its incorporation in 1898, the Shawinigan Water and Power Co. has grown to be the fourth largest distributor of electricity in the world: it controls in the form of electricity or hydraulic supply nearly 600,000 h.p. The St. Maurice River is one of the largest rivers in the whole of Canada. It has its

source at the divide between the valley of the St. Lawrence and the watershed of Hudson Bay at a point about 300 miles north of the former river, and it drains a region of nearly 20,000 square miles Practically the whole drainage region is forest or

woodland, a circumstance which is most favourable for maintaining constancy of river flow. In a part of its course, the waters of the river descend more than 250 ft. within a distance of a dozen miles, and it is here that the principal power stations have been developed.

Shawingan Falls was the site of the first development, and it is now the centre of the Company's generating and transmission system. Located about twenty miles from the junction with the St Lawrence, the curvature of the St. Maurice at this point, where the fall is 150 ft., lends itself admirably to economical exploitation. The first installation, completed in 1902, consisted of two 5000 h p. water wheels and generators, now incorporated in Power House No.

1, the capacity of which was raised in 1910 to 58,500 h.p. by the addition of four units of 11,500 h.p. Power House No. 2, begun in 1911, with two 20,000 h.p. units, received a third unit in 1912; two additional units in 1914, and a sixth unit of 45,000

Canada, Ltd., and 15,000 h p. to the Belgo-Canadian Paper Company in the form of hydraulic power.

At Grandmère, which is six miles above Shawinigan, the power development of the Laurentide Power Company, Ltd., an allied concern, comprises

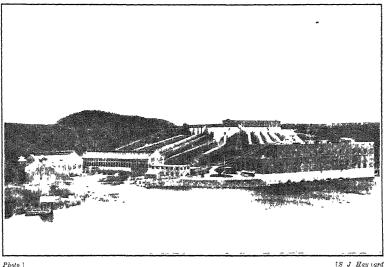


Fig. 3—Snawingan Power Station. Capacity, 145,000 H P

Reproduced by permission of the Shawingan Water and Power Company.

six 20,000 h.p. units and two 22,000 h.p. units, with provision for a final unit of 22,000 h.p. to be installed in the future. The total capacity at present is 164,000 h.p.

The latest addition to the Company's generating

system is an installation of 120,000 h.p. at La Gabelle, seven miles below Shawinigan. This was completed and put into operation in 1924. Provision has been made for the addition of another unit of 30,000 h.p.

In the short stretch of about a dozen miles of river between La Gabelle and Grandmère, there are, therefore, three hydro-electric generating stations having a total capacity of 507,500 h.p. The local storage ponds of the three stations are under unified control and a balance is maintained of the electrical loads so that the water is utilised to its full extent in passing down the river.

Through a subsidiary company (the North Shore Power Company) the Shawinigan Water and Power Company completed and put into operation last year

another installation of 22,000 h.p. at St. Narcisse on the Batiscan River (about 20 miles below the St. Maurice River), replacing an installation of 1600 h.p., reputed to be the first in the British Empire to supply energy over long-distance transmission.

The question of transmission is, of course, an

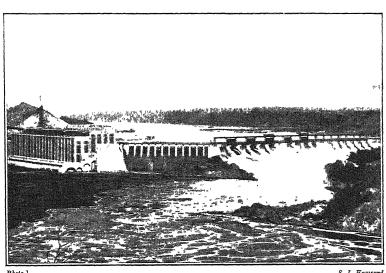


Fig. 4—Grandmère Power Station. Capacity, 164,000 H P.

Reproduced by permission of the Shawinigan Water and Power Company.

h.p. in 1923; thus bringing the total capacity up to 145,000 h p. at the present time. There is contemplated the installation of two more units of 45,000 h.p. each; so that, when completed, the total electrical capacity of Power Houses Nos. 1 and 2 will be 293,500 h.p. In addition, 50,000 h.p. is supplied to the Aluminium Company of

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important problem in dealing with the supply of energy from the generating centres to the various localities of consumption. The Shawmigan Company transmits 3-phase alternating current at 114,000 volts over four lines to Montreal, and the high tension used, together with the large amount of current passed, necessitate very careful insulation. Aluminium is largely taking the place of copper for the cables of transmission lines, and this step is opening out an important industry in the production of aluminium from bauxite. The

300 miles of steel tower and steel pole voltage lines and about 400 miles of high voltage wood pole lines, with more than a thousand miles of wood pole lines of low voltage. The lines on the southern route to Victoriaville cross the St Lawrence River one mile above the city of Three Rivers, by means of an overhead crossing which is one of the largest in existence, both as regards length of span and height of tower. The distance between the two towers is 4800 ft, which, with the anchorage spans on each bank, gives a total length of 6324 ft of

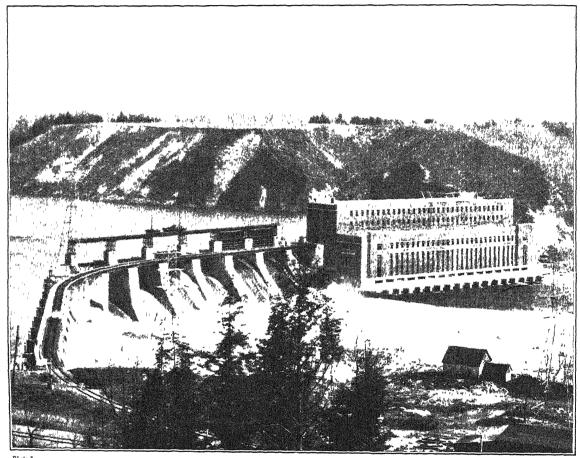


Photo ?

FIG. 5 —La Gabelle Power Station Capacity, 120,000 H P Reproduced by perimission of the Shawingan Water and Power Company.

[S J. Hayward.

process is being developed among other places on the Saguenay River, where the bauxite is imported from districts in Central and South America, to be treated with the aid of the local hydraulic power.

The high voltage transmission lines forming the trunk lines of the Shawinigan system radiate from Shawinigan Falls westward to Montreal (85 miles), eastward to Quebec (55 miles), and southward across the St. Lawrence River to Sherbrooke and the Thetford Mines Asbestos district Three general types of support are in vogue: steel towers, steel poles, and wood poles. Of these, the steel structures are the more permanent. There are

crossing. The towers stand 375 ft. above the foundation level. The minimum clearance above the water is 165 ft, so as to admit of the passage of ocean liners between Montreal and Quebec.

It would be possible to dwell at considerable length on the development of water power in the Province of Quebec alone. In addition to the Gatineau River, the St. Maurice River, and the Saguenay River installations, to which reference has been made, there are a number of minor installations of cumulative importance, some of which in time will form the nuclei of future groups of power centres Projects which are in hand, or under active consideration, include a 65,000 h.p.

development on the Prairie River, near Montreal, by The Montreal Island Power Co a 50 000 h p development at Spicer Fall on the St François River, by the Southern Canada Power Co 40,000 h p plant at Mountain Fall, on the Rouge River, by the Canadian International Paper Co a 50,000 h p addition to the Ottawa River Power Company's installation at Bryson, and a number of lesser calibre.

The Quebec Streams Commission continues a very useful and beneficial work in fostering waterpower development in the Province. The Commission has extensive storage reservoirs established on the St Maurice and St François Rivers Kenogami Lake Ste Anne de Beaupré and Mitis Rivers, all of which are at present reported as filled to capacity, the various plants in connexion therewith being thus assured of an ample supply of water during the winter season. The Commission now has under its supervision the construction of the Baskatong reservoir on the Gatmeau River, which is at the point of completion. This reservoir is formed in part by Baskatong Lake, and has a capacity of 94 billion cubic feet, it serves to regulate the flow to 8000 cubic feet per second Other work of the Commission includes surveys and investigations of likely projects, some of which will materialise in due course.

The Province of Ontario includes, of course, the world-renowned Falls of Niagara, or, at any rate, the Canadian portion of them The Ontario Hydro-Electric Power Commission recently completed two large stations, the Queenston on the Niagar River with 550,000 hp development, and the Cameron Falls on the Nipigon River with 75,000 h p development The Queenston Station is now fully loaded, and for the further supply of the Niagara system the Commission has entered into a contract with the Gatineau Power Company for the delivery of from 230,000 to 260,000 h p over a 220,000 volt line, commencing next year

In Northern Ontario, the Abitibi Power and Paper Co has completed the transmission line from its 48,000 hp. plant at Island Falls to the mills at Iroquois Falls. The town of Cochrane is also served from this line A short distance to the west, the Spruce Falls Co. has in hand the

construction of works at Smoky Falls on the Mattagann River which will result in the obtainment of 70,000 hp, which will be utilised to supply energy to the Company's pulp and paper mills in the district

In the extreme west of the Province, a 17 000 h p. development at the western outlet of the Lake of the Woods has been achieved by the Keewatia Power Co In the same district the Bachus Brooks Co has undertaken the construction of three power sites on the Seine River, which will have an aggregate capacity of 37,620 h.p. It is expected that all three will be completed and in use by the end of the current year

Important developments are in progress in British Columbia and Manitoba, but as these are much farther afield than the writer's ambit, only very brief allusion will be made to them tormer Province there are works in hand on the Kootenav and Powell Rivers while the British Columbia Electric Railway Company's dam at the Alouette lakes, eight miles north of the Fraser River and about 25 miles due east of Vancouver, has proved a valuable addition to the supply at Stave Falls A project promoted by the same Company at Bridge River is designed for an initial capacity of 54,000 h p . which may ultimately reach a total of from 550,000 to 700 000 hp. In Manitoba, the City of Winnipeg and the Manitoba Power Company have made notable additions to their respective installations

There is not, however, quite the same inducement in the Western Provinces of Canada to exploit water-power as in the Provinces of Quebec and Ontario Coal is procurable, and although not of high quality, yet the power situation is not so compulsory or so drastic as if no alternative source were available It is therefore in the Eastern Provinces, with their conspicuous lack of coalmines, that the greatest and most sustained effort is being made to develop water-power, and the foregoing notice of the steps which are being taken to remedy a striking deficiency in the natural fuel resources of the country, so obviously prejudicial to the development of its industry and commerce, can scarcely fail to interest those whose duty it is to survey the field of Nature and exploit it in the interest and service of mankind.

### The British Association at Leeds.

IN the phraseology of our trans-Atlantic cousins, the Handbook for the Leeds meeting may have 'said a mouthful' when it describes the area visited this year by the British Association as a 'conurbation,' but behind the word a very important feature of this year's meeting is struggling, if clumsily, for recognition. Proximity of population, and the interlacing of road and rail communication, make the area of the West Riding of Yorkshire one urban unit with a population between one and a quarter and one and a half millions. At the same time, local civic spirit proclaims its divisibility into independent units every whit as

strenuously as the physicist splits up the chemist's The unmitated visitor must not confound Dewsbury with Batley, or (as the provisional issue of the time-table did !) Halifax with Huddersfield; his crime is as great as that of the visitor to the Western States who assumes that Los Angeles and San Francisco are much the same thing

The Englishman may pay about the same high price for grape fruits from California and Florida, but this is a mistake condemned on entirely different grounds, and equally emphatically, by both these States; similarly, local championship individualises the products of the local looms, and in its own

way has nothing to learn from the Florida story of the turtle masquerading in the Californian visitor's blankets as a bed bug, to demonstrate the scale of things in Florida These civic rivalries kev up the pace of life in the West Riding, both in industry and in sport Local league cricket is in a different world from the country cricket of the west of England, and the Whitsuntide rival counties of the White and the Red Rose are credibly reported on that occasion to say "How do on their first morning, afterwards nothing but How's that!"

In such an area, visits to works and to educational and civic institutions by interested Sections, can be almost indefinitely continued, each city or borough having its own lesson to teach Similarly, the Association's meeting is characterised by a very large extension of the list of citizens and childrens lectures, an experiment which will be watched with interest. These lectures are still somewhat a new development, and there is sometimes a difficulty in utilising the favourable opportunity to attract a general audience to listen to science which is created by the general publicity associated with the meeting.

The Handbook has a very interesting chapter by the editor. Dr. C. B Fawcett, upon the location of Leeds, which began as a foothill town on the eastern edge of the Pennines. Its central position, halfway between the south coast and the Highlands, between London and Glasgow, and between North and Irish Seas is naturally emphasised Leeds citizens at present consider themselves centrally placed also for the dissolution of the series of

from the Atlantic and apparently disperse in rain down the flanks of the Pennines. At the same time, from the north of Scotland, from Ireland and the Isle of Man, and from the Riviera, holiday makers return with tales of days spent in sunshine

August has had an exceptionally heavy ramfall record, and the visitors when in the gardens of their hosts are asked to remember that for most days of the last month it has been quite impossible to work upon the sodden land have of necessity been altered. Section K (Botany) which always enjoys splashing about a swamp, as it did with success both at Southampton and in Canada, had arranged to visit the interesting marsh at Askham, near York, referred to by Mr Sledge in his botanical notes in the Handbook This marsh was quite maccessible a few days before the meeting, and the Yorkshire papers still record flood conditions in various parts of the three Ridings that are quite remarkable for the season This year the adventurous visitor to Gaping Ghyll should certainly find the 340-foot waterfall descending this pothole an impressive if damp experience

The maugural meeting was held in the Majestic Cinema, which possesses a very large auditorium. The overhead lighting was strengthened specially for the occasion, so that the audience should both

be able to see and be seen

On Tuesday, Sept 6, the R W Provincial Grand Master of West Yorkshire, the Viscount Lascelles, K G, will attend a meeting at the Masonic Hall, Great George Street, to welcome visiting members who are Freemasons HRH Princess Mary will \_ also attend the Civic Reception to be held at the depressions which follow in melancholy succession | City Art Galleries on Thursday night, Sept 1.

# The Stone Age in Kenya.

THE brief reports which have reached England from time to time of the discoveries relating to the stone age in Kenya by Mr. L S B. Leakey (see NATURE, July 16, p. 85) have pointed to the possibility that evidence of great importance for the early history of man in this part of Africa might be brought to light at any moment. The announcement, therefore, that a preliminary report on the excavations recently carried out by Mr. Leakey and Mr. B. H. Newsam, with the advice and co-operation on geological points of Dr. Nilsson and Mr. E. J. Wayland of Uganda, would be presented to Section H (Anthropology) at the meeting of the British Association at Leeds had been received with considerable interest. In the absence of the authors, who will return to England later in September, the report was communicated to the Section by Dr. A. C. Haddon

The work covered by the report is in the nature of a preliminary survey and deals with the results of excavations in two areas, one in the neighbourhood of Lake Nakuru on the floor of the Rift Valley, the second at Upper Elmenterta.

Before dealing with the present discoveries, it may be recalled that ever since 1893, implements and obsidian flakes, some accompanied by pottery, have been found in Kenya Some of these were surface finds, others were situated at a depth of two to three feet Some, again, were obtained from the high level beaches of the Rift Valley Among them also were implements comparable to the palæolithic implements of Europe, and in some cases they were associated with the remains of extinct animals. Similar finds have been made in Uganda, and Mr. Wayland has classified these implements into three divisions. Reference may also be made to the skeleton found in the Oldeway Gorge in 1914 which was associated with fauna now extinct.

Turning now to the results of Mr. Leakey's first year's work on the Nakuru site, evidence was found for at least two periods of high lake-level reaching to 6604 ft. above sea-level as against the present 5768 ft. In relation with these high levels there was evidence for falls to a point below the 200-ft. level It is suggested that these high levels represent pluvial periods to be correlated with the glacial epochs of Europe This suggestion awaits further examination in the light of evidence to be furnished by fossil bones and shells collected from the various horizons in the lake deposits.

The archæological site at Nakuru is situated

365 ft above present lake-level and consists of a The two upper deposit along the edge of a cliff strata show no sign of a submergence and therefore must be later than the high lake-level In these upper strata, ten burials were found distributed through a depth of 13 ft With them were large numbers of implements and pottery fragments as well as stone bowls, the latter being more numerous in the upper levels. One skeleton was found in perfect condition and alone afforded material for detailed measurement. The notable characteristics were the length and width of the face and the great depth of the mandible at the symphysis, the height of the palate and the prominent nose with a low index of 50. The skull is markedly dolichocephalic The associated industry is essentially microlithic Beneath these two strata and obviously earlier in date, was a small deposit of sand and pebbles which had been subject to the action of water This contained a few obsidian flakes, the tools being for the most part backed blades

At Upper Elmenteita two sites were investigated The first is at a height of 393 ft above present lakelevel, and is situated on the edge of a cliff which consists of lava overlying an alluvial deposit The cliff is one side of a valley which was cut by a prehistoric river during an interpluvial period, and afterwards filled by a rise of the lake, most of the later alluvium being washed away in a subsequent In this later alluvium, which lay in pockets in recesses and crevices, were found the remains of twenty-six individuals scattered about at various depths with obsidian tools, pottery, stone mortars. and eggshell beads. It is suggested that these individuals belong to a period previous to that at which they were deposited where they were found All the bones are more or less fossilised and well preserved There are at least two skull types Elmenteita A is a primitive type Remarkable features in the mandible are the depth at the symphysis—11 mm—the thickness of the horizontal ramus and the relative height of the ascending ramus. The angle is also remarkably obtuse Other notable features of this type are the low forehead, the length and breadth of the face, and the exceptionally long and narrow nose, of which the index is 47.4 The skull is dolichocephalic, its index being 68.2 The second type, Elmenteita B, is not so primitive as Skull A, differing from it tools.

m its greater breadth, the index being 75. It has a remarkably high cranial capacity-1660 96and an exceptionally narrow nose with an index Neither of these types resembles the modern negro of the country

A cave or rock-shelter at Elmenteita, situated at a height of 594 ft above present lake-level, produced important stratigraphical evidence. Eleven horizons were exposed, of which the first three were modern and showed no tools, the fourth was alluvial, and the fifth composed of

debris from the roof The sixth produced implements and pottery, the eighth was alluvial, and the ninth rock rubble, while the tenth was an occupation hearth layer with obsidian tools and The eleventh contained burnals. If, as is argued, the alluvial deposits at four and eight are to be identified with the high lake-levels, the first or later prehistoric period belongs to the second interpluvial and the lower or earlier culture to the first interpluvial Of the two cultural horizons, the first or later belongs to the neolithic in culture if not in date and is to be compared to the Elmenterta site (Monro's Faria), while the earlier contains a much cruder industry without pottery, the implements being rough flakes showing just a very small trace of secondary chipping In the lowest level, 14 ft below the surface, have been found traces of burnals, but at the time the report was written no human remains had been taken out

The most conclusive evidence as to the age of the industry with lunate and backed blades was found in a drift across the Enteril River, giving a clear section across the alluvial plain at a level of 330 ft above present lake-level and showing very clearly the deposits during the high-level periods In the deposits of the last pluvial period are a number of obidian tools, chiefly lunates and backed points, definitely associated with fossil bones which would seem to belong to some form of hippopotamus

Taking the results of the investigation as a whole, they would go to show the occurrence of two high lake levels indicating two pluvial periods, the existence of stone age cultures earlier than both the high lake-level deposits, and in the case of the earliest deposits antedating the earlier rise of the lake, human remains are associated with crude

# Obituary.

SIR HARRY JOHNSTON, G.C.M.G, K.C.B.

THE death of Sir Harry Johnston removes one to whom the British Empire and science owe Henry Hamilton Johnston was born great debts at Kennington on June 12, 1858, and he died near Worksop on July 31 last at sixty-nine years of age He was educated at the Stockwell Grammar School, King's College, London, and later at the Royal Academy Schools. Endowed with great natural ability and with a vigorous and fearless mind, he soon displayed an amazing versatility which led him to success along many different paths. Distinguished as an artist in water colours, an intrepid explorer, a naturalist, an anthropologist, a linguist, and a writer, he won for himself a permanent place in history as one of the builders of Great Britain's African Empire and as a wise colonial administrator Political activities, alone or in conjunction with Cecil Rhodes, Sir Alfred Sharpe and others, constituted the most important part of Sir Harry Johnston's life-work An excellent account of these activities was published in the Times for Aug 1.

Although he had visited Tunisia previously, Sir Harry Johnston's connexion with Africa may be said to date really from 1882, when he accom-

panied Lord Mayo on a journey through southern Angola. Thence he marched away northwards by himself to meet Stanley on the Congo. journey and his book ("The River Congo") describing it displayed the power and resource of the young explorer. As a result he was chosen to lead the scientific expedition to Kilimanjaro organised by the British Association and the Royal Society. Politics, science, and art marched with Johnston on this, as on all later occasions; the fruits of the expedition were important biological collections, a valuable book ("The Kilimanjaro Expedition"), and a crop of satisfactory treaties with the native chiefs In 1885, as vice-consul in Cameroon and the Niger Delta, Johnston showed his capacity for courageous Later came special missions to, administration or long spells of administration in Nyasaland, what is now called Northern Rhodesia, British East Africa, Uganda, and Liberia, where his labours in Africa terminated in 1906.

In spite of all difficulty and danger, and of the pressure of onerous duties, Sir Harry Johnston never lost his early enthusiasm for Nature and art. No administrator in Africa or elsewhere has ever done so much as he did to advance science in the countries under his control. His own contributions to science were many, his explorations of Kilimanjaro, Ruwenzori, and the Semliki Forest, the discovery of the okapi, anthropological investigations among the pygmics and other African people, and studies of the native languages being among the most important. Firm in the belief that white rule in Africa depends ultimately upon a complete knowledge of the country, its natural history, its people and their institutions, Johnston lost no opportunity to collect information and material himself, and what was still more important, he urged all his subordinates to the performance of a similar duty. He was too wise to fritter away his time in a vain attempt to work out everything for himself. On one occasion one of his lieutenants was heard to grumble. "I collect endless mammals and birds," he said, "but Sir Harry won't look at them. All he says is, 'Put them in the box.'" But in due course the boxes came home to South Kensington to play their part in building up our knowledge of African zoology.

Sir Harry Johnston wrote many books dealing with natural history and exploration; of these the most important are "The Kilimanjaro Expedition" (1885), "The Uganda Protectorate" (1902), and "Liberia" (1906). Lucidly written and charmingly illustrated by reproductions from the water-colour paintings of the author as well as by good photographs, these books are of permanent scientific value as sources of original information. Despite its weight and its date, the best guide that the traveller interested in natural history can carry in West Africa is the second volume of "Liberia." In addition, Sir Harry Johnston also wrote various political works, novels, and a play.

The present writer first saw Johnston at a meeting of the Zoological Society of London in 1905. He knew that appearances were often

deceptive; yet he found it hard to believe that the dapper little man reading out a long list of native names for animals in a curiously high-pitched voice could be in the sterner places of the world the strong leader of men. A broad view of this remarkable man and of his life and work seems to suggest comparison with another great pioneer of Empire---Raleigh. There are differences of course. To-day the way of the universal genius is both harder and easier than it once was; thanks to science and the press, so many have now become vocal that genius, unless it be of the narrow specialist kind, has difficulty in making itself heard above the general din and very little chance of being remembered in the restless seas of modern distraction. Had he lived three centuries ago, Johnston would have become a popular hero and he would have gone to the block; to-day, except on those rare occasions when he chanced to share headlines with the doubtful figures of a cause célèbre, Raleigh would attract little attention and would die quietly in bed. M. A. C. H.

Notices on the life of Dr. Carl H. Eigenmann, by David Starr Jordan and Fernandus Payne, in Science, vol. 65, No. 1691, give good accounts of the work of this eminent ichthyologist, able teacher, and indefatigable explorer, who died on April 24 A student under Prof Starr Jordan, he succeeded him in 1891 as professor of zoology in Indiana University, and in 1908 was made dean. For some years he was curator of fishes in the Carnegie Museum, Pittsburg, and in 1895 he established a fresh-water biological station in Northern Indiana, of which he was director up to a few years before his death. One of his most important works is on the blind cave fishes of North America, and for the purpose of collecting material for this study he made expeditions to the cave regions of Indiana, Kentucky, Missouri, Texas, and Cuba, and for the detailed exploration of the fish fauna of the Amazon and other Brazilian rivers he made four trips to South America, besides sending students on other expeditions. In all, 195 new genera, containing about 600 species, were defined by Eigenmann and his colleagues, and his technical papers number upwards of 170. It is an interesting fact that Dr. Eigenmann entered the university as a student in Latin, but most fortunately it was not too late to change when in his second year he discovered that his tastes were zoological rather than classical.

WE regret to announce the following deaths:

Mr. G. C. Champion, who collected entomological material for Godman and Salvin for their "Biologia Contrali-Americana" and contributed largely to the published work, on Aug. 8, aged seventy-six years.

Mr. Alban H. G. Doran, who collaborated with Sir James Paget and Sir James Goodhart in the compilation of the second edition of the Catalogues of the Pathological Series in the Museum of the Royal College of Surgeons, and also prepared a descriptive Catalogue of Surgical Instruments in the Museum, on Aug. 23, aged seventy-seven years.

### News and Views.

Ar the maugural meeting of the British Association at Leeds on Aug 31 a message was received from HRH the Prince of Wales expressing regret at his mability to attend in person to welcome his successor to the office of president, of whom he says "I have reason to believe that when any one in this country digs up a bone his first instinct (subject to the intervention of the police) is to send it to Su Aithur Keith" Referring to his own presidential address at Oxford last year, His Royal Highness suggested that his choice of subject, "Science and the State," has been justified by the emphasis which was afterwards laid upon the value of scientific research to imperial development at the proceedings of the Imperial and Colonial Office Conferences. This recognition, he considered, places it beyond doubt that "more general attention for the objects of science" is in process of achievement. He expressed the opinion that an increasing measure of public support should be accorded to the British Association for the furtherance of this object. Fortunately, its powers have been very materially strengthened during the past year, through the splendid generosity of Sir Alfred Yarrow, m making it a gift of £10,000 for general purposes.

Undoubtedly, the address of the royal president of the Association at Oxford last year did much to focus public attention upon the function of the scientific worker in the social organism. It informed the non-scientific members of the community, in language perfectly intelligible to them, what science has achieved, what the nation can achieve if it applies the scientific knowledge it already possesses, and the nature of those further problems confronting the world, for the solution of which the scientific worker is indispensable. The Leeds address of Sir Arthur Keith may be said to stress the spiritual aspect of science as contrasted with the material aspect dealt with by his predecessor—It is equally remarkable for its breadth of outlook and its freedom from mitating and unnecessary technicalities and obscurities of language which mar so many addresses on scientific topics. It would be well, perhaps, if the Council of the "so-called parliament of science" would consider the possibility of msisting that at least every sectional president should also deal broadly with his particular branch of science in order that the general public and members of others sections might be in a position to appreciate its implications. Papers dealing with a highly specialised piece of research are, as a general rule, best delivered before members of a learned society. Judging from some of the sectional presidents' addresses and papers read or to be read at Leeds, it would appear that the essential difference in function between a section of the British Association and the corresponding learned society, or between the British Association as a body and the Royal Society, is not sufficiently appreciated. It happens that this year only four of the presidents of the thirteen Sections are fellows of the Royal Society, whereas usually the number is six or more.

The instructive survey of man's physical nature and history displayed by Sir Arthur Keith in his address is sure to attract close attention. The address is printed in full in a Supplement to this week's issue, and the statement it contains as to the present position of Darwin's theory of man's descent will be welcomed by a wide circle of readers. We need not follow the survey here, but there are certain aspects of the search for the elusive line of man's direct ancestry which force themselves to notice Many discoveries of remains of fossil men have been made since Darwin's day - It is remarkable how little they have helped to unravel the direct stages of the ascent of modern man, and how many have been side-tracks off the main line, so that, in the terms of the genealogical tree, the branch of modern humanity has become beset by a thicket of collateral branches. We do not yet know the place of origin of the human branch, for although the weight of evidence points to close relationship in some sort with the anthropoid group, other possibilities have been advocated, each founded on legitimate arguments Indeed, it seems as if association with one or another existing type of monkey depends upon the choice of the particular structure upon which the stress of comparison is laid. Even as regards existing man, we cannot yet trace each living race indubitably to its place of origin on the ancestral tree.

May it not be that in searching for each minute intermediate stage in a series, we search for something which may not have existed, that we are still too much dominated by the idea of the rise of species by way of the continuous minimal variations which Darwin so effectively advocated 9 Did we but understand in full the possibilities of the correlated development of parts, the difference between basal variation and correlated sequence, we might cease to expect m the development of each and every structure a complete series of nunimal gradations, and be freed from the bogey of the 'missing link.' Such difficulties do not affect the main story of the ascent of man Every discovery bearing on the problem made since Darwin's day, whether it be morphological, embryological, physiological, psychological, or biochemical, has confirmed the general thesis of Darwin that man is an offspring of the animal world and that his nearest existing relatives are the higher apes; as Sir Arthur Keith puts it, "the fundamentals of Darwin's outline of man's history remain unshaken. Nay, so strong has his position become that I am convinced that it never can be shaken."

Some six hundred delegates, of whom more than four hundred are from the British Isles, arrived in Montreal for the official opening on Aug. 22 of the second triennial Empire Mining and Metallurgical Congress. The Congress has been organised by ten separate mining and metallurgical institutes from Great Britain, South Africa, Australia, India, and Canada. At the first morning's session, the chair was taken

by Sir Robert Horne, the honorary president, who with the Honourable Charles Stewart, Canadian Minister of the Interior and president of the Congress, delivered inaugural addresses. The Congress will be divided into two sections for a comprehensive tour of all the Dominion's mining centres. One tour goes right through Canada by special train to the Pacific coast, while the other confines its attentions to central and eastern Canada. On Aug. 23, the delegates left Montreal by special train for Ottawa and the Niagara Falls. Technical sessions were held in Toronto on Aug. 25 and 26.

The Empire Mining and Metallurgical Congress has endorsed unanimously a resolution proposed by Mr. R. E. Palmer, president of the Institution of Mining and Metallurgy of London, embodying the suggestions, contained in the paper read before the Congress by Sir Thomas Holland, for the survey of the mineral resources of the Empire. Sir Thomas urged the necessity of reviewing for each unit of the British Empire the mining resources for smelting capabilities with the view of accumulating in addition to the ordinary official statistics the essential data necessary for the formulation of an Empire economic policy. The British Empire produces about a quarter of the total mineral production of the world of nearly two billion tons; but it is not independent and completely self-contained in respect of mineral requirements, and it might be desirable to carry surplus stocks of vital mineral necessities which could be drawn upon in any temporary emergency, such as, for example, in the case of nickel in the time of the War. The Congress adopted the resolution as a move towards achieving a comprehensive tabulation of the Empire's mineral and industrial resources.

A NEW forestry society, termed the Society of Foresters of Great Britain, has been founded during the past year. The idea originated amongst some of the younger forest officers under the Forestry Commission; and though it is laudable enough, doubts have been expressed as to the wisdom of taking the step so soon after the inauguration of the Commission and whilst the number of trained foresters in Great Britain is so small. There exist already in Britain the Scottish Arboricultural and the English Arboricultural Societies and the Empire Forestry Association, whilst at least three other societies can lay claim to an interest in forestry or arboriculture. Neither of the three societies mentioned above can be considered to be in an overwhelmingly strong financial position. It was perhaps natural to ask whether there was room for yet another, even though its aim and object was to restrict membership to fully-trained and qualified foresters. This qualification had to be waived and associate members admitted in order to enable the society to be started. Those interested in forestry in Great Britain will watch the new-born plant with interest, but not without anxiety. For societies of this kind cannot be maintained without funds, and the man of science and the technical officer have

many calls of this nature made upon them now-adays; and to expect a jumor or even semior officer to belong to three societies all, according to their articles of membership, among at the same end, is rather a severe trial

IT is fully recognised that a technical society of the type referred to above loses half its utility and interest unless it is represented by a journal recording both its own progress and that of the science which it represents. The new society was not unmindful of this necessity. The first number of its journal, entitled Forestry, has recently appeared. It is an ambitious publication issued in beautiful style by the Oxford University Press and contains articles\* of considerable interest. But the question at once arises in the minds of those acquainted with present costs and the habits and requirements of professional men, especially forest officers -Can the money be found to maintain this high quality, and can the interest be maintained in a publication issued only once a year · for this is the present announced intention? If issued more frequently, can the high interest of the present number be maintained? We hope that, in parliamentary phrase, the answers to these questions are in the affirmative; for old hands know that they are vital to success.

It is expected that some two hundred organisations will be represented at the fourth conference of the Association of Special Libraries and Information Bureaux which meets at Trmity College, Cambridge. during the week-end Sept. 23-26. Following reception by Sir J. J. Thomson, Master of Trinity, Sir Geoffrey Butler, senior M.P. for the University of Cambridge, will deliver the presidential address, whilst among the many well-known experts giving papers are Sir Henry Lyons (Director, The Science Museum), Mr. A. E. Overton (Principal, Board of Trade), and Sir Richard Gregory. The subjects to be discussed at the Conference include such topics as the recent Report of the Public Libraries Committee, co-operation between libraries, and book selection in science and technology. Sectional meetings will be held on information and statistics in commerce and industry, on patent classification and on information bureaux questions. The Conference is open to all interested, whether members of the Association or not; a copy of the detailed programme and other particulars can be obtained from the Secretary, Aslib, 38 Bloomsbury Square, London, W.C.1. With the assistance of the Carnegie United Kingdom Trustees, the Association is publishing in the autumn a directory of sources of specialised information, edited by Mr. G. F. Barwick, late Keeper of Printed Books at the British Museum. The book is unique in character inasmuch as it records under thousands of subject headings the various centres in Great Britain and Ireland to which those in search of specialised information

THE importance of the issues involved in prehistoric chronology and archæology must be our excuse for a

further reference to l'affaire Glozel The scenticism of l'Abbé Breuil and Mr O. G. S. Crawford has received further support from M. A. Vayson de Pradenne in the Bull. de la Société Préhistorique Française, No 6, M. de Pradenne, a personal friend of Dr Morlet, has visited Glozel, himself excavated on the site, and carefully examined the collection of engraved bone objects, pottery, clay tablets, and stone implements in the collection of the peasant Fradin through whom the site was brought to light and of Dr. Morlet himself, by whom it was made known to the scientific world. So far from concurring in the Magdalenian or derived Magdalenian origin of this remarkable association of alleged prehistoric objects, M de Pradenne in convinced that they are not ancient. Two points in his investigation are particularly striking. The material of the bone objects exhibits none of the marks of a high antiquity. Its character is either that of fresh bone which has been boiled, or old but not ancient bone which has been exposed to the weather, and the marks on it have evidently been made by a metal implement, and he formed the conclusion, which he verified in the case of an implement that he himself unearthed, that the soil immediately surrounding the objects found was not in the same state as that of the rest of the stratum. This latter opinion was formed after investigating the harder as well as the looser strata. M de Pradenne's relations with Dr. Morlet add weight to his views. It seems unlikely that we shall hear anything more of this site worthy of serious consideration in contradiction of the conclusions which have now been formed after a fair and, we think it may be affirmed, impartial examination of the facts. It is scarcely necessary to emphasise the harm done to archaelogical science by the hasty and ill-considered world-wide dissemination in the daily press of sensational alleged discoveries which prove on investigation to have no foundation.

TRINITY HOUSE IS now constructing radio beacons for assisting navigation at various points round the English coast. These beacons send out distinctive radio signals at regular intervals and thus are intended to enable vessels fitted with direction finders to determine their position. During darkness and in foggy weather, these installations will be a great aid to marine navigation when ships are approaching land and will add appreciably to the safety of life at sea. The first beacon station to be put into commission by Trinity House is situated at Round Island in the Scilly Isles. It is operated on a wave-length of 1000 metres (a frequency of 300 kilocycles), which will be the standard for radio beacons. It has been designed by the Marconi Company to the specifications of Trinity House. It is automatically controlled by a master clock and transmits groups of continuous wave-signals—in the case of Round Island the letters GGG in Morse code—at predetermined Every precaution has been taken to diminish the risk of a breakdown. All running machinery, including the master clock, is duplicated. If a valve burn out it is immediately replaced automatically and a warning signal notifies the attendant. The radio mast consists of a steel lattice tower 60 feet high, and the aerial is supported at a height of 50 feet. The signal for 'Fair' weather consists of the call sign repeated for 47 seconds, followed by a prolonged dash of 10 seconds' duration, and terminated by one repetition of the call sign, the whole transmission taking 60 seconds exactly. A silent period of three minutes then follows. In fair weather this cycle is repeated three times every half-hour. In foggy weather the one-minute transmission and three minutes silence are repeated continuously. In a normal ship's receiver, the bearings can be received accurately up to a distance of about 100 miles.

PROF. EDWARD WESTERMARCK has accepted an invitation to deliver the Frazer Lecture at Glasgow in 1928. It will be remembered that the lectureship is vested in four universities in Great Britain in rotation and this time the election falls to Glasgow. In view of the fact that the British Association will be meeting in Glasgow in 1928, the University has decided that the date of the lecture shall coincide with the date of the meeting, in order that those may have an opportunity of attending the lecture who otherwise might not be able to travel so far as Glasgow at another time.

LORD MORTON'S chestnut mare, which is supposed to have produced a quagga-horse hybrid about 1814, and afterwards to have produced, by a black Arabian stallion, three bay foals resembling the quagga in some of their markings and in having more or less erect manes, has long been cited as evidence of telegony. The inheritance of coat colour in horses is now known. Chestnut is recessive to all other colours, and the series runs grey, dun, bay, black, chestnut, grey being dominant to all others. Prof. Cossar Ewart has shown that in zebra-horse hybrids, the horse colours are dominant to those of the zebra. It is also well known that horse-donkey hybrids take the colour of the horse. In the light of these facts, Mr. James Wilson (Sci. Proc. Roy. Dublin Soc., vol. 18, No. 41) concludes that the quagga was not the father of the supposed quagga-horse hybrid, since the latter was bay while the mother was chestnut, and could only produce a bay foal by a bay, dun, or grey father. Hence any evidence of telegony falls to the ground.

The International Hydrographic Bureau, of which the principal maritime nations are members, is chiefly concerned with the co-ordination of surveys and chart production. The latest issue of the *Hydrographic Review* (vol. 4, No. 1, May 1927), which is published by the Board at intervals of about a year, contains articles on the organisation, equipment, and methods of the Norwegian, Swedish, and Danish Hydrographic Services, and on various subjects germane to navigation and cartography. Amongst these, Rear Admiral A. P. Niblack, U.S.N., presents a plea for the extension of oceanographic research, particularly the study of ocean currents, which are of international interest, and the study of which is intimately linked with marine biology, meteorology, and fishery research.

The review contains a bibliography of contemporary publications and articles concerning oceanography in the widest sense of the term, this should be of value to all who are interested in the science of the sea.

APPLICATIONS are invited by the Zoological Society of London for the Anatomical Research Fellowship, tenable for three years with a possible extension for two further years, of the annual value of £400, and for an Aquarium Research Fellowship, tenable for three years, of the annual value of £350. Applications must be sent to reach Dr P Chalmers Mitchell, Zoological Society, Regent's Park, NW8, before Nov. 1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :-- An Inspector of Agriculture in the Sudan Department of Agriculture and Forests-- J Nield Cameron, Old Vicarage, Wetherby, Yorks. (Sept. 15). An assistant lecturer in mechanical engineering at King's College, London-The Secretary, King's College, Strand, W.C 2 (Sept. 16). A graduate assistant in the Information Bureau of the British Cotton Industry Research Association—The Secretary, British Cotton Industry Research Association, Shirley Institute, Didsbury, Manchester (Sept. 17). A lecturer in mining at the Denbighshire Technical Institute, Wrexham-The Secretary and Director of Education, Education Offices, Ruthin (Sept. 17) A reader in pathology at Westminster Hospital Medical School—The Academic Registrar, University of London, South Kensington, S.W.7 (Sept. 23). A jumor technical officer at the

Royal Augraft Establishment for work in the specification section of the Wireless and Photographic Department -The Chief Superintendent, RAE., South Farnborough, Hants (Sept. 24, quoting No A 210) A professor of chemistry and a professor of English language and literature in the University of Melbourne - The Agent-General for Victoria, Victoria House, Melbourne Place, Strand, W.C 2 (Oct 1) Two assistants, one male and one female, in the Plant Pathological Laboratory of the Ministry of Agriculture and Fisheries, Harpenden—The Secretary. Ministry of Agriculture and Fisheries, 10 Whitehall Place, SW 1 (Oct 1). A lecturer in biology and a lecturer in chemistry in the University of Western Australia-The Agent-General for Western Australia, 115 Strand, W.C 2 (Oct. 1). A research fellow m bacteriology at the Lister Institute of Preventive Mediene-The Secretary, Lister Institute of Preventive Medicine, Chelsea Bridge Road, S.W.1 (Oct. 8) A professor of mathematics and a professor of education at Raffles College, Singapore CA (N), The Secretary, Board of Education, Whitehall, S W 1 Scottish candidates (N), The Scottish Education Department, Whitehall, S.W.1 (Nov. 1). An assistant in the Research Department, Woolwich, under the directorate of metallurgical research. The Chief Superintendent, Research Department, Woolwich, An assistant lecturer in economics in Auckland University College—The High Commissioner for New Zealand, 415 Strand, W.C.2. A chief assistant in the Domestic Science department of Battersea Polytechnic The Principal, Batterson Polytechnic, S.W.11.

### Our Astronomical Column.

COMET GALE.—Mr. Walter F. Gale, the discoverer of comets 1894 II. and 1912 II., has sent particulars of the discovery of comet 1927 f. He was sweeping the neighbourhood of Theta Piscis Australis with a Zeiss binocular just after midnight on June 7, and picked up a small faint nebulosity, the comotary character of which was quickly verified with his telescope He obtained approximate positions on the next three nights (incidentally these positions suggest that Prof. Gonnessiat's observation of June 10 was inadvertently telegraphed half a degree too far north); these, together with a rough position on June 25 by Townsend at Hawera. New Zealand, afford material for an approximate orbit, which Dr. A. C D. Crommelin has deduced as follows: T: 1927 June 14·30 U.T.;  $\omega$ : 212° 35′;  $\Omega$ : 66° 38′;  $\imath$ : 12° 40′, log q 0 1030. The small value of i suggests the possibility that the orbit may be periodic. The distance from the earth at discovery was 0 43 astr. units. The comet still remains too far south for convenient observation in England. Some observations were made at the Cape, which have been sent to the I A.U. Bureau at Copenhagen. It is noteworthy that three of the four unexpected comets discovered this year are due to British observers, as is also the detection of Comet Grigg-Skjellerup on its return

Later.—The Cape observations, now to hand, suggest that Gonnessiat's declination is right and Gale's

wrong.

VENUS.—Mr. H. McEwen, director of the Venus Section of the British Astronomical Association, contributes an interesting paper to the July issue of the Jour. B.A.A. He quotes the radiometric measures

of Coblentz and Lampland from which Monzel deduced a surface temperature of 122" F., which bears\* to that of the earth the proportion of the inverse squares of distances from the sun. He also uses the temperature measures to advance an argument in favour of the period of rotation and position of axis announced by Prof. W. H. Pickering; the period was about 3 days, and the inclination so high that the tropics would be within 5° of the poles. Under these conditions the poles would be for most of the time the hottest regions of the planet, for they would have a very high sun continuously for a large fraction of the planet's year. The measures indicated that one cusp was much hotter than the other, this being the one where the sun was setting, whereas the other had cooled during the night. The spring equinox of the northern hemisphere is stated to occur when the planet's heliocentric longitude is 316°6, the other seasonal points being found by successive additions of 90°

Pickering's view is that the planet is practically covered with oceans, so that there would be no surface markings of a permanent character. Those that are seen are presumably atmospheric. Mr. McEwen shows that their changes are in good accord with the atmospheric circulation that would result from such an axial pose. When the pole is nearly central on the disc, there would be little rotational velocity in the line of sight; but this should be appreciable when the pole was near the limb.

The writer has made out a good case for the view he advocates, and it may at least be adopted as a working hypothesis. The rotation has long been a puzzling enigma, and any further light is welcome.

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### Research Items.

Dreams in Africa —In Man for August, Mr. J. P. Driberg records a number of dreams of different types and their interpretation which he has collected, at the suggestion of Prof C G Seligman, among the Lango and Didinga of the south-eastern Sudan The Lotuko-speaking Lango provide eleven varieties of dream, the Didinga fourteen. Among the Lango no greater significance attaches to the dream of a magician than of a layman, but among the Didinga, although the magician does not have a different class of dream from that of the layman, all his dreams have a greater significance, and if the significance is ill-omened a sacrifice must be made of a bull or a goat to avert the threatened evil Among both peoples the significance of many of the dreams is a simple prognostication. For example, among the Lango a dream that some one kills the dreamer is considered a true forecast, to dream of killing an elephant means that one will do so, among the Didinga, to dream of hunting means that success on the next expedition will correspond, and so forth. Certain dreams, however, have a special significance the Lango, to dream of being carried away in a flood causes the dreamer fear, though whether this is because of an ill omen is not clear. To dream of being bitten by a snake is a very bad omen. A piece of charcoal must be bitten and spat out and the dreamer must prick himself with a thoin Among the Didinga, a similar use of charcoal and thorns follows on a dream that A kills B by witchcraft The dreamer must the next day call on B, bite a piece of charcoal and spit it on B, rub soot on his forehead and scratch him with thorns. The same procedure follows a dream that 1 accidentally spears himself; but it must be done immediately on waking even if this involves a journey in the night. To dream of falling in the fire must be followed by the sacrifice of a white goat and the tying of a goatskin bracelet on the person of whom one dreams.

Beth-Shan in 1926.—In the Museum Journal (Philadelphia) for March, Mr. Alan Rowe surveys the work carried out by the Palestine Expedition of the University of Pennsylvania at Beisan in the season of 1926. In addition to the actual work of excavation on the Tel and in the vast cemetery to the north, a comprehensive survey of the area was made, which showed that the original top of the mound was 346 ft. below the level of the Mediterranean, and the height 213 ft at the north and 134 ft. at the south Eight successive periods are represented by superimposed layers, but the occupation of some of the principal buildings extended from one period to another, they being used over and over again. For example, the two temples of Rameses II, which are identified as the House of Astaroth and the Temple of Dagon of the Bible, and belong to the fifth level dated 1295-1225 s.c., were used until at least Israelitish times, say 1000 s.c. The period covered by the eight levels extends from some date before 1412 B.C. not yet determined down to modern times In 1926 all the strata from the second to the eighth were worked. Up to the present that of Amenophis III, the seventh, is regarded as the most important. The material recovered from this level admits of certain inferences of great historical importance. Among the finds are a number of inscribed Syro-Hittite cylinder seals, a bronze Syrian dagger, and a Hittite axe-head of which one end is in the shape of a hand with outstretched fingers, unique but similar to an axe held by a Hittite king on a sculpture at Boghaz-Keui. This affords supporting evidence of the extent of the advance of the Hittites known to be taking place at about this time into North Syna—Further, the model of a chain or throne of Cretan (Minoan) type with Egyptian emblems and a model of a table, also of Cretan type, doubtless parts of a group of cult objects, with other finds, point to an infiltration during the Bionze Age of Ægean influence via Cyprus, of which the final phase was represented by the domination of the non-using Philistines—This Ægean-Cypriote influence in the old religion of Palestine was not recognised fully before these discoveries at Beth-Shan

The Insects of Samoa —Reference has recently been made in these columns to a monograph dealing with the insects and other land arthropods of Samoa that is being issued by the British Museum (Natural History) This work is based upon collections made by Dr P. A Ruxton and Mr. G. H E Hopkins, who visited the islands under the auspices of the London School of Hygiene and Tropical Medicine in 1924-25. Within the last few weeks three new tascicles of this monograph have come to hand Micro-lepidoptera are dealt with by Mr. E. Meyrick and his contribution forms Fasc II of Part 3 It appears that scarcely half-a-dozen named species of these insects were recorded from Samoa before the recent of the present collection, which raises the total number to 137. Of these, two-thirds of the species are endemic, and the remainder also occur elsewhere, being probably introduced through shipping. Mr. Meyrick concludes that Samoa constitutes, by the test of specific endemicity, a perfectly distinct and isolated faunal region. Another noteworthy feature is the total absence of representatives of the families Pterophoride and Ecophoride from the indigenous fauna. Part 2, Fasc. I. is devoted to certain families of Hemptera. The Fulgoroidea are dealt with by Mr. F. Muir, who finds that eight families, twentyseven genera, and fifty-one species are now known from the islands. He describes a new genus, Buxtoniella, the systematic position of which appears to be an enigma but it is relegated to the Lophopida. The Psyllida are reported on by Prof. D L. Crawford, and Mr F. Laing has dealt with the Coceda, Aphidide, and Aleyrodide. Part 7, Fasc I. contains Mr (4. F. Hill's account of the Termitide and Lieut. Col. Fraser's description of the Odonata.

ACCELERATION OF PLANT GROWTH.—At the Boyce-Thompson Institute for Plant Research in New York, experiments are being carried on for the purpose of investigating the conditions necessary to accelerate plant growth In a News Bulletin recently issued by Science Service of Washington, Dr. John M. Arthur gives a review of the work being carried on. - The results include spring wheat harvested 35 days after sowing, red clover in flower 38 days after seeding, and a large head of lettuce grown in three weeks. These remarkable results have been obtained by the use of artificial light, heat, and atmosphere process of photosynthesis in a plant is somewhat inefficient, only about one per cent. of the radiant energy falling on its leaves being utilised More than a century ago de Saussure showed that green plants could utilise more carbon dioxide than is actually available in the atmosphere, but no application was made of that fact until the War. Then, under pressure of food shortage in Germany, processes were perfected by Riedel and others for scrubbing gases from combustion of coal, coke, and charcoal to produce carbon dioxide, which was piped into greenhouses among growing plants. With high temperature and high light intensity, a concentration of less than 0.5 per cent of carbon dioxide (the normal amount present in the air is 0.03 per cent.) just about doubled the dry weight of plant tissue produced. Similarly, many plants can use more light than they get in Nature. If such plants are kept continually under an arc lamp, or if artificial light is used to supplement daylight, their growth is hastened. Wheat and clover can stand 24 hours of light a day. The tomato, however, grows fastest with 12 hours of daylight supplemented by 6 hours of artificial light. Unfortunately, commercial application of these facts is not yet in sight, and will not be until electrical power can be produced at a much cheaper rate than at present.

WEED SPRAYS —Mr A. Aslander, in the Journal of Agricultural Science, vol. 34, p 1065, describes some interesting experiments with weed sprays. Cornellian oats and field mustard (Brassica arrensis) were grown together in pots and sprayed when the mustard had developed four leaves. Concentrations of 5-15 per cent. of iron sulphate and 1-2 per cent. of sulphuric acid were used, and after the treatment the pots were kept under various conditions of humidity In all cases the oat plants were uninjured by the sprays, but the effect on the mustard varied. Iron sulphate was only effective when the relative humidity was high (100 per cent.), a 5 per cent. solution completely killing the plants in twenty-four hours under such conditions, whereas in dry air (relative humidity 30-60 per cent.) concentrations up to 15 per cent. were used without injury. The effectiveness of sulphuric acid, however, was much less dependent on the humidity, though the best results were obtained in dry air. The plants were completely killed by 1.5 or 2 per cent. solutions, the higher concentration being necessary if the soil in the pots had been kept dry. Temperature had a marked influence on the effect of the spray. Whereas at 30° C., a 2 per cent. solution proved tatal after one hour, at 60 ('., the same result was only obtained after five hours. Artificial rain, produced by sprinkling the plants with water, failed to decrease the action of the acid; Experiments with Elodea canadensis bore out the spraying results with mustard, since protoplasmic streaming continued for two hours in a 10 per cent. solution of iron sulphate, but ceased in 30 seconds in I per cent. sulphuric acid.

NEMATODA OF THE LEIDY COLLECTIONS .-- A. C. Walton has examined the extensive collection of Nematoda made by the late Dr. Joseph Leidy and presents the first of a series of reports on this material (Proc. Acad. Nat. Sci. Philadelphia, vol. 79, pp. 49-163; 1927). The worms were obtained chiefly from American hosts, but a few were from imported animals in captivity in America. Many of the original Leidy species are present in the collection, and in some cases it has been possible to designate type specimens. The main interest of this account is that it contains descriptions with drawings of species which, since Leidy's time, have been either unrecognised or but doubtfully identified by later workers. More than a hundred definitely recognised species are recorded, twenty-four of which are described as new. Appended is a list of hosts and their respective Nematoda.

OIL IN MUD FROM SEA-FLOOR.—Some interesting research on the oil-content of sea-bottom muds and sands accumulating at the present time is being conducted by Dr. P. D. Trask, of the American Petroleum Institute. Samples of muds were taken from shoalwaters off the coasts of Southern California and North Carolina; such samples are then subjected to destructive distillation and other chemical and physical tests.

According to Science Service, No. 326 F. Washington, D.C., of June 25, 1927, oil was produced from all these types of sediment; "the yield was low, and in general varied in amount with the degree of fineness of the sediments, ranging from a maximum of 2.7 gallons per ton in a clay-silt to almost nothing in a sand. This maximum yield of 2.7 gallons per ton is but 5 or 10 per cent, of the amount obtained from the better grades of oil shale, which ruin from 30 to 50 or even more gallons per ton." This work has obvious bearings on modern theories of the origin of petroleum, particularly those which invoke marine mother-substance and primary environment; so far it is only in the preliminary experimental stage, but it is backed by a grant from the John D. Rockefeller fund of the Institute, and exhaustive investigations along these lines are contemplated.

IONISATION POTENTIALS OF MERCURY - Dr E. O. Lawrence, who recently obtained very strong evidence that the ionisation potential of mercury was multiple, with at least four distinct types of melastic electron impacts between 10.6 volts and 12.1 volts, has described experiments in the July number of the Journal of the Franklin Institute, in which he has confirmed this with different apparatus. In the earlier form, he obtained a homogeneous pencil by magnetic sorting: with the present arrangement he has worked with electrons from an oxide-coated filament, with a thermal distribution of velocities. He used very small electron currents, of the order of 10<sup>-9</sup> amp., and measured the positive ion currents by a null electrometer method, employing a slightly modified Lenard system of fields. There is little doubt that the effect is real, and not due to some action of magnetic fields, or to diffusion of positive ions, but it would be interesting to repeat the work with other monatomic gases, and with a continuous variation of the accelerating potential.

OPTICAL ISOMERISM. In a recent paper in the Zeitschrift fur Physik on the quantum theory of polyatomic molecules (vol. 43, p. 805), Dr. F. Hund arrived at an interesting paradox. According to his analysis, molecules possessing the mirror symmetry associated with optical activity should not have stationary states which correspond to small displacements from the two main positions of equilibrium, but should undergo transitions between the right and left handed forms. This is evidently not in agreement with the permanence of the properties of many optically active substances. The solution follows when the expression for the average time of life in either state is evaluated numerically. This contains an exponential term involving the internal energy, and seven-fold increase of the latter could change the time of relaxation from 10 second to 10° years. It seems as if apparently stable bodies of this class are actually undergoing slow spontaneous transformation into an inactive mixture which contams equal quantities of the lavo and dextro forms.

Low-Temperature Process. The Chemiker-Zertung of July 16 contains an account, given by Dr. F. Simon of Berlin at the recent meeting of the Deutscher Kalteverein, of a new laboratory method of producing low temperatures by pumping adsorbed gases from charcoal, silica-gels, or from zeolites. Thus helium, adsorbed by charcoal and cooled by immersion in liquid hydrogen, could be further cooled to  $-269^{\circ}$ C. The process is not continuous, and is at present only available for the production of small quantities of liquid helium, hydrogen, and other gases.

A CRYSTALLINE POTASSIUM HYDROGEN DIOLEATE.

—No acid soaps of definite composition analogous to

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the two acid sodium acetates have been shown to exist. In the Journal of the Chemical Society for June, McBain and Stewart describe the preparation of the first definite crystalline compound of this type observed with soaps. Potassium hydrogen dioleate is prepared from oleic acid and potassium oleate in alcoholic solution. Well-defined crystalline plates separate on cooling in ice. The substance shows a transition point at 43°, at which it breaks up into potassium oleate and a solution of oleate and oleic acid. On account of the ease with which it crystallises from alcoholic solution, it offers a means of purifying oleic acid.

SULPHUR DIOXIDE IN FOOD —The determination of sulphur dioxide in foods forms the subject of the Ministry of Health Report on Public Health, No. 43, recently published by H.M Stationery Office (1s 3d net). The only preservatives now permitted to be used in foods and drinks are benzoic acid and sulphur dioxide. The determination of benzoic acid has already been dealt with in Report No. 39 of this series, and the present Report deals on similar lines with sulphur dioxide. Although the Public Health Regulations specify the total amount of sulphur dioxide permitted in various foods, no distinction between free and combined sulphurous acid is made It is, however, important to know the nature and extent of the combination between sulphur dioxide and certain constituents of food, since the presence of comparatively stable compounds with sulphur dioxide will affect the determinations unless due precautions are taken. The sulphur dioxide is separated from combination on the addition of alkali or on distillation with acid. Gravimetric determination as barium sulphate gives accurate results in nearly all cases.

IGNITION TEMPERATURES AND 'ANTI-KNOCK' IN-VESTIGATIONS -The effect of small amounts of lead tetraethyl and other substances in allaying the 'knock' which occurs with some fuels under certain conditions in an internal combustion engine has evoked considerable interest. Much work has been done on the effect of various compounds on the knocking characteristics of fuels by Egerton and Clates, and we have received a series of four papers reprinted from the Journal of the Institution of Petroleum Technologists, vol 13, No. 61, April 1927, which summarises their work. The first three papers deal with the effect of metallic vapours on the ignition of substances, the significance of ignition temperatures, and the offect of certain organic compounds on the igniting and 'knocking' character of petrol. The fourth paper reviews the above work and discusses the reasons for the effects observed. It suggests processes of combustion and ignition and supplies a theory of 'anti-knock' action A full report of this work was sent to the Aeronautical Research Committee, and is also summarised in the Air Ministry's Reports and Memoranda, No. 1079, which has recently been published. The experiments show that the use of anti-knocks' retards the initial processes of combustion and the 'anti-knock' may be regarded as a negative catalyst which reacts with and removes those substances which autocatalyse combustion Ten theories which have been advanced in explanation of the action of anti-knocks are briefly described, including Callendar's nuclear drop theory (see Nature, April 9, p. 542). With regard to the latter, it is remarked that no account is taken of the chemical behaviour of 'anti-knock' compounds, and experi-ments show that more is required of an 'anti-knock' than protection or dilution of the droplet. There

is reason to expect that Callendar's suggestions may come in as a secondary effect, and by concentrating the dope in the droplets the tendency would be to enhance its effect where most required

ELECTRICAL APPARATUS FOR MINES.—A further report on flame-proof electrical apparatus for use in coal-mines, by H. Rainford and R. V. Wheeler, has just been published (Safety in Mines Research Board Paper, No. 35 London: H.M. Stationery Office). The research was made principally to discover the means of preventing the flames due to firedamp explosions which sometimes occur within the casing of electrical apparatus from passing to the outside atmosphere. Experiments were also made on the ring-relief device, which is intended to provide additional means of pressure-release when the volume contained by the casings is large. In this case neither flange nor perforated plate protection, as shown in previous reports, is adequate. The ring-relief device consists roughly of a number of metallic rings separated from one another by narrow radial distance pieces. These are assembled in the form of a cage and held securely in position by a circular brass end plate which is connected to the end plate by bolts. The interior of the casing is thus in communication with the outer air by the series of gaps formed by the separation of the rings. The general conclusion drawn from the experiments described in the report is that the use of the ring-relief device forms both a satisfactory method of releasing the pressure due to the fire-damp explosion in the interior of the electrical apparatus and also prevents the passage of the flame to the outside. The British Electrical and Allied Industries Research Association assisted in carrying out the work.

The Action of Lightning Arresters.—Devices called 'lightning arresters,' or electrical safety valves, have been in use for many years to protect electrical machines, more particularly those which are connected with overhead systems of distribution. phenomena that take place on electric lines during thunderstorms are well known. Sparks take place from conductors to neighbouring conductors connected with the earth. If the electric pressure of supply be high, an arc may be established, causing a short circuit, which may overstress the dynamos or burn out the device, leaving the system unprotected. At the recent international conference on high tension supply in Paris, Mr. McEachron, of the General Electric Co, U.S.A., gave a theory of the action of the safety-valve which explains well what happens in practice. During a thunderstorm, owing to the electrically charged clouds, quite appreciable charges of electricity are induced on the conductors. A lightning flash sets these charges free by suddenly altering the potentials of the clouds. The charges now travel in both directions along the conductors, half of the initial electrostatic energy being converted into electromagnetic energy. The potential gradient of the wave-front causes the safety-valve to act, and if a sufficient charge passes to earth in a very brief interval, the pressure drops to its working value, the valve ceases to operate, and the system again works normally. In California, a working voltage of 220 kilovolts is employed. It was thought that the necessary high insulation would completely protect the line. This it fails to do. Even when fourteen disc insulators in series are used to support the conductors, 'flash overs' occur repeatedly. This proves that the impulse voltage causing them must exceed 2000 kilovolts. The insulation only breaks down when the time of application of the applied voltage is excessive.

# Research and Industry in South Africa.

THE Union of South Africa, although possessing so small a population (1,672,000 whites), employs the scientific worker and the engineer to an exceptional extent, and progress in the Union is correspondingly remarkable. Forty years ago the country was sparsely populated and scarcely possessed a factory. In 1925 the gross value of the output of its industries was estimated at £79,789,000, and that of its mines at a further £50,000,000.

Much of this progress is directly due to the intelligent employment of scientific and engineering skill, In gold-mining, the discovery of the cyanide process made possible the present output of more than £40,000,000 a year. The handsome profits obtained, in spite of the low grade of most of the mines, have been made possible by the application of years of research and experiment to the development of metallurgical processes, the cheap production of electricity, explosives, and compressed air, and to the design and handling of rock drills and jack-hammers.

Fortunately, this is now fully realised by the financial heads of the mining industry. Apart from the central research laboratories of the groups, some of the larger mines have their own 'study departments, the staffs of which devote their full time to research, experiment, and instruction in methods likely to reduce costs. In the best mines only men with technical training as well as practical experience are employed on this work; and they are well paid.

In some countries agriculture is popularly regarded as one of the most empirical industries. In South Africa the local peculiarities of soils, the varieties and virulence of pests and diseases, and the irregularity of the rainfall, early led to a special call on the services of the research worker and of the civil engineer. In spite of the disadvantages mentioned, South Africa now exports more than ten million pounds worth of farm

products a year.

So long ago as 1911, four highly paid posts were created for research on the fertility of seeds, whilst the large veterinary research institute near Pretoria was founded in 1908. There are now, in addition, five schools of agriculture with experimental farms, and also a national herbarium. There is a department for the study of bacterial diseases of plants at Protoria, and a government laboratory at Durban for the study of the sub-tropical diseases of the sugar-cane and allied plants. Durban also possesses a private institution for research on problems met with in the sugarcane industry. At Cape Town there is a government laboratory for the study of the diseases of deciduous fruit trees.

The Department of Agriculture maintains a special experimental farm for the study of the resistance of plants to drought and frost, and also two chemical laboratories (Cape Town and Johannesburg), equipped

for both analytical work and research.

Students who wish to take up the scientific study of agriculture complete a preliminary three years in South Africa and then proceed for a further two years. usually aided by a government scholarship, either to Guelph, Ontario, or to Denmark or Sweden. Those taking up veterinary sciences for the degree of B.V.Sc. take a two-years' preliminary course at an approved college or university in South Africa, and then a threeyears' course at the Institute at Onderstapoort near Pretoria

That the application of the results of such study and research may be made to yield good profits or, alternatively, to prevent heavy losses, is now widely appreciated by the majority of the farmers in South Africa, but not by all. A story is told of one old cattle

farmer, the local oracle of his district, who did not believe in blood tests for disease. Such tests are carried out tree of charge if the suspected animal is found to be intected, whilst a small fee is charged if a negative is obtained. This farmer sent a sample of his own blood to the government laboratory and widely proclaimed his eleverness in devising this pitfall for the - --! (gentlemen) who spend the poor farmers' taxes in such foolery. In due course the report was received by him. It stated that a mistake had been made; the blood sample was not from any farm animal but appeared to have been taken from an old gorilla which was suffering from the list of diseases attached and was apparently in such a bad condition that it should be killed at once. The report also stated that, in accordance with the regulations, no fee would be charged for the examination of the sample submitted. The farmer was not heard proclaiming his views on this subject any more.

In connexion with forestry, as apart from farming, a small sylvicultural research station has been established near Knysna in Cape Colony and the establishment of similar stations is contemplated in other Timber investigations are carried out at Pretoria by the Department of Agriculture in cooperation with the Railway Administration. Relevant inquiries from the public are dealt with by the officer

of this section.

Medical research has received particular attention in South Africa, and expenditure has been on a lavish scale. Apart from the outstanding investigations on the prevention of silicosis and pneumonia on the mines, much work has been done on epidemic influenza by the South African Institute for Medical Research. Eighteen memoirs have been published on these and other subjects. The chief medical school of the Union is at Johannesburg

In mining, apart from the central laboratories of the mining groups and the efficiency and study departments of the larger mines, the Department of Mines and Industries carries out much research work. Health, safety, and particularly the prevention of mmer's phthisis, are the subjects dealt with by the latter. Recently, in conjunction with the Geological Survey, special attention has been given to exploring the commercial possibilities of mmeral deposits, particularly those of the base metals and the non-metallic minerals. The subject of uses and markets overseas receives special attention.

In chemical industry, still in its mfancy in South Africa, private enterprises have carried out a large amount of work on local problems such as the manufacture of wattle bark extract, refractories, phosphates, caustic soda, acetates, paper, starch, wood and coal distillation products, and rubber from the raw materials occurring in the Union. Promising local research is now being carried out on yet another process for the 'liquefication' of coal, and on the distillation of oil from the local shales and torbanite. Practical experience and systematic experiment have been successful in establishing the local manufacture of leather, soap, candles, calcium carbide, cement, glass, tiles, and earthenware.

The production of iron, steel, and alloy steels from local ores is only just commencing, although the utilisation of the immense supplies of scrap metal from the mines was more or less perfected during the period

of the War.

With so much interest in research, and so much development in industry, it is not surprising that South Africa has many scientific societies, most of which publish their own proceedings and maintain a high

standard in the contributions of their members. In Johannesburg an interesting venture is the Technical Club, an attempt at a social club for the members of the scientific societies which contribute to its upkeep. The club successfully houses the offices of the secretaries of the contributing societies; but as in London, scientific workers do not seem to be anxious to see each other in the evenings except at the meetings of their respective societies. At the universities, on the other hand, there is a considerable amount of social intercourse, a good esprit de corps, and keen competition in games; but in both the scientific societies and the universities the importance of research to industry and of industry to the country is keenly appreciated.

Industry already employs many thousands of whites and blacks in addition to the thousands employed by the mines With its firmly established agriculture, its fine geographical position with regard to the growing markets of the East, its vast national resources of coal and iron, its fine railways and good harbours, and its wide appreciation of the value of research, the future of the South African industries should be bright indeed.

### The Food of Young Herring.

In the investigation of the food contents of large batches of small herring (Fishery Board for Scotland, Scientific Investigations, 1927, No. 1, "Observations on the Food of Post-Larval Herring from the Scottish Coast"), Miss Helen S. Ogilvie, of the Fishery Board for Scotland, has an exceptional opportunity. The fishes examined measured about 30 mm. to 45 mm., and were metamorphosing, having a more or less transparent body with, in the larger specimens, scales in the process of formation. Hitherto it has been far more difficult to find such stages than to find the fully scaled forms which are slightly older and larger and constitute the 'white-bait'. These post-larval stages have now been found in abundance in the coastal waters and up the estuaries in the neighbourhood of Aberdeen. Lot No. I was taken outside Aberdeen Breakwater, Lot No. II off North Pier, and Lot No. III, examined for comparison with the other two, from Kincardine-on-Forth.

Observations have been made on the food of very young herring and of those of whitebait size, but not so far to any extent on post-larval herring between these stages. The present work is therefore extremely valuable. As was to be expected, the food found consisted almost entirely of copepods, the commonest species being Pseudocalanus elongatus and Oithona similis, and, in those from Kincardine, Eurytemora hirundoides in great abundance, which last is a brackish water copepod, the station where the third sample was caught being an estuarine one. One fish belonging to this group measuring 45.5 mm. contained 369 copepods. Another from Lot II measuring 40 mm. contained 479.

Miss Ogilvie finds, contrary to those workers on the younger stages who found many empty, that nearly all the herring examined were feeding. Out of 345 individuals, 95·4 per cent. contained food. In fishes of the same size examined by Hardy from the North Sea, only 46 per cent. contained food. Moreover, more food was found in the Scottish herring than in those from England. One particular copepod was the chief food in each lot. Thus in Lot I Pseudocalanus was predominant, in Lot II Oithona, and in Lot III Eurytemora. All three copepods are some of the commonest present where the fishes were respectively taken, and it seems more a matter of size than anything else which determines the species eaten.

### University and Educational Intelligence.

London.—Applications are invited for the William Julius Mickle fellowship, value not less than £200 and open to men and women graduates of the University, resident in London. The fellowship is for the student who, in the opinion of the senate, has done most for the advancement of medical art or science during the preceding five years. Applications should reach the Academic Registrar, South Kensington, S.W 7, not later than Sept. 30

Dr. R. M. Wenley, who has been acting as director of the British division of the American University Union, is about to return to the headship of the Department of Philosophy and Psychology in the University of Michigan.

APPLICATIONS are invited by the Wigan and District Mining and Technical College for the A. M. Lamb scholarship in mining, value £30 annually and tenable for three years at the full-time courses of the college. Particulars can be obtained until Sept. 7 from the principal.

Notice has been received of the Prof. Aurelio Bianchi International Prize of 10,000 lira (about 100 guineas) for "works in phonendoscopy, phonendography, phonendometry" of an experimental character. The prize is open to persons of all nationalities and to individual workers or several persons working in collaboration. Memoirs must not have been published before, and may be in Italian, English, French, German, Spanish, or Portuguese. The competition closes on May 24, 1928. Further particulars can be obtained from the Rector, Royal University of Perugia.

Titles of theses for doctorates conferred in the sciences by American universities in 1925–26 are given in a list published by the National Research Council as Reprint and Circular No. 75 (N.R.C. Washington, D.C., 50 cents). The list is classified under twenty-one subject headings, and statistics of doctorates conferred under each of these headings are given for the past ten years. During this period the number of doctorates conferred annually has increased from 373 to 740, the increase being greatest under chemistry (from 108 to 256). The Council expresses the hope that those who find the data of interest will write, so that the Council may judge whether the publication should be continued.

Bradford Technical College opens this year a new department of pharmacy, particulars of which are given in the college prospectus for 1927–28. The courses are recognised by the University of London and the Pharmaceutical Society of Great Britain for the purpose of training for the degree of bachelor of pharmacy and for the Society's professional examinations respectively. A special feature of the College is the provision made in its department of commerce and banking, established in 1925, for meeting the needs of students who will enter the commercial side of industrial undertakings or such professions as accountancy, and for equipping students in all branches of technology with a useful knowledge of economics. Three research scholarships of £100 each are offered to students proposing to stay on at the College after completing diploma courses.

# Calendar of Discovery and Invention.

September 5, 1862—James Glaisher, who was the first superintendent of the magnetical and meteorological department of the Royal Observatory on its foundation in 1840, and was also the founder of the Royal Meteorological Society, made many balloon ascents for scientific purposes, the most notable of which was that made from Wolverhampton on Sept 5, 1862, when a height of nearly seven miles was attained

September 6, 1863—It was on Sept. 6, 1863, that Philipp Reis (1834–1874), a professor of Frankfort-on-Mame, explained to the Emperor of Austria his 'telephon' for transmitting musical sounds to a distance. Reis probably designed ten distinct forms of transmitter and four forms of receiver. Some of his apparatus is to be seen at the Science Museum, South Kensington A Reis 'telephon' was also experimented with by Hughes, who exhibited the instrument to the Emperor Alexander II. of Russia at Tsarskoye Selo in 1865

September 6, 1870.—The need for the application of scientific methods in designing and building ships has often been brought home by disasters at sea, of which the loss of H.M.S. Captain is perhaps the most notable. Built on the Mersey to the plans of Captain Cowper Coles, the Captain was a fully-rigged low-freeboard turret vessel 320 feet long and 6950 tons displacement. She was completed in 1870, and after preliminary trials she joined the Channel Fleet off Finisterre, but on the night of Sept. 6-7 capsized, 475 officers and men being lost. An outcome of the tragedy was the appointment of a Committee of Design, on which Armstrong, Rankine, Kelvin, Woolley, and Froude served, while much more extensive investigations into the question of stability of ships was undertaken than had hitherto been the case

September 7, 1807.—Winsor's success in lighting Pall Mall with gas in January 1807 had far reaching effects and also led to extravagant speculation. Winsor himself lectured and gave demonstrations, and on Sept. 7, 1807, Lady Bessborough, writing to the Earl of Granville, said. "Winsor promised a return of 6000 guineas a year for every guinea subscribed. No fewer than 17,000 shares were sold in ton days, and Pall Mall was blocked with people in carriages, on horseback, and on foot rushing to invest."

September 8, 1859.—After many delays, the famous Great Eastern proceeded down the Thames on trial on Sept. 8, 1859. She had then been five years under construction. About as large as our present Mauritania, her machinery was only about a seventh of the power. She had both screw and paddles, but her combined horse-power was only some 9000 H.P. Moreover, she had but 25 lb steam pressure in her boilers, and her coal consumption was very high. It was the backwardness of marine engineering that, as much as anything, made it impossible to make her pay.

September 9, 1892.—"On Sept. 9, 1892, Mr. [Prof. E. E.] Barnard was studying Jupiter with the large telescope at the Lick Observatory, which has an aperture of three feet, and as the light of the planet produced too great an illumination of the field of vision, he carefully intercepted it, whereupon he noticed a feeble luminous point nearer than the first satellites. At first he thought it was a small star, but as the days passed all such doubts were removed, and it became clear that here was indeed a fifth moon, situated at no greater distance than 113,475 miles from Jupiter's enormous globe. . . Few observers are powerfully enough equipped to perceive this tiny world, whose diameter is only some 90 miles" (Moreau).

E.C.S.

### Societies and Academies.

Paris

Academy of Sciences, July 25 André Blondel. Abacus for the resolution of the general equation of the third degree and the discussion of the differential equation of the third order with constant coefficients. Paul Sabatier and Antonio Fernandez Dehydrogenations and hydrogenations catalysed by metallic oxides. In previous communications the catalytic behaviour of various metallic oxides has been mamly studied by the reactions with alcohols. Pipendine has now been submitted to similar experiments The reduction of nitrobenzene and alkyl nitrites by hydrogen in the presence of manganous oxide or zinc oxide has also been studied D Wolkowitsch. A geometrical interpretation of Castigliano's theorem in a particular case—G. Pfeiffer: The construction from a system of partial differential equations of the first order with an unknown function, of an equation, lmear in Jacobians, satisfying Hamburger's conditions, and also of a system of equations, linear in Jacobians, for which the generalised conditions of Hamburger are fulfilled. Serge Bernstein The The multiply monotone polynomials which deviate the least from zero A. Veronnet: The most general movement of an isolated heterogeneous fluid mass, which keeps an invariable form. The trajectories are circular and the level surfaces of revolution. -Swyngedauw: The unfolding of belts. D S. de Lavaud. The stability of the vibrations of the front axle and wheels of a motor-car. Rebillet · Carburation in internal combustion motors. A general formula is given for the weight of air drawn into the motor in a given time and a mechanism described and illustrated by means of which the petrol injected can be made to follow the same law. Léon Kuste. The practical limit to increase of size of commercial aeroplanes. E. M. Antoniadi. Recent observations of the planet Mercury with the Meudon 83 cm, telescope

Carl Stormer: Remarkable action of sunlight on the height of the autrora borealis. On Sept. 8, 1926, the height of an aurora measured on a 26 kilometre base at Oslo was found to be 300 km, 500 km, above the earth, instead of the average 80 km, 200 km. This aurora was directly exposed to sunlight, and examination of earlier data showed that a high aurora was usual when exposed to the rays of the sun. The spectrum of the high aurora gives lines in the blue and violet which are not shown by the low altitude aurora H. Deslandres: Remarks on the preceding communication. Mlle J. Clavier. Study of the reflecting power of some unoxidisable steels. Four non-rusting steels were examined and their reflective powers measured for eight different wavelengths. One group of mirrors was exposed to the air for two months; the other group was kept away from air and moisture. The measurements were practically identical and show that these steels possess the qualities of a good material for reflectors. -G. W. Ritchey and Honri Chrétien: Presentation of the first model of an aplanatic telescope. Edmond Bayle and Lucien Amy: The application of spectrum analysis to the detection of metallic impurities. A modification of the method of Jolibois and Bonnet, m which the metal is first deposited electrolytically. A list is given of the minimum amounts of various metals capable of detection by this method, varying from  $1 \times 10^{-6}$  gm. of silver to  $1 \times 10^{-10}$  gm. of manganese.—L. Dunoyer: The measurement of the gases dissolved in water. The method is based on the evaporation in a high vacuum of a small quantity of water (1 c.c. to 2 e.c.), absorption of the water

White the money property of the

vapour by phosphorus pentoxide, and measurement of the pressure produced by the evolved gas results are higher than the figures usually accepted -A Colani Study of the systems uranyl sulphate, alkalme sulphate, water, at 25° C—Félix Taboury
The basic carbonate of beryllium. The decomposition of the ammonium beryllium carbonate does not give the substance indicated by Debray, but a more basic carbonate still containing ammonia Even after prolonged washing with water charged with carbon dioxide, it is extremely difficult to remove the whole of the ammonia —Max and Michel Polonovski A scopinium derivative. reduction to  $\psi$ -scopine and degradation to m-oxybenzaldehyde —Emile André and Mile. M. The François. Contribution to the study of the marine animal oils. Researches on the unsaturated fatty alcohols of spermaceti oil—Mine. Ramart, Mlle. Laclôtre, and M. Anagnostopoulos The action of the organo-magnesium compounds on the a-trisubstituted primary amides Whilst mono-and di-substituted acetamides give ketones when condensed with organo-magnesium compounds, the trisubstituted acetamides yield nitriles —Raymond The solubility of 1-phenyl-2 3-dimethyl-4 - dimethylamino - 5 - pyrazolone in water — Branco Dimitrievitch · The conditions of deposit of the axinite of Mont Avala (Serbia) -Ch Mauguin. The study of muscovite mica by means of the X-rays.—P Corbin and N. Oulianoff The difference and the resemblance of the crystalline schists of the two slopes of the Chamonix valley (massits of Mont Blanc and Aiguilles Rouges)—Jean G. Popesco: A variation of terrestrial magnetism.—A. Lebediantzef: The modifications of the introgenous substances in earth dried in the open air and left fallow.—A. Mordvilko · Anolocyclia in the Pemphigus of Pistachia.-F Henrijean. New researches on the heart and the electrocardiogram -Philippe Fabre: Relation between the linear constant and the chronaxy. (h. Champy and Th. Keller · Uterme and mammary development by mjection of ovarian hormone.—J. Houget, Andro Mayer, and L. Plantefol: A particular form of biological oxidation.—L. Margaillan Remarks on the oil of grape pips.—R. Fosse and Mllc. V Bossuyt The estimation of allantoic acid as xanthylurea. Application to the analyses of the leaves of Acer pseudoplatanus.

#### SYDNEY.

Linnean Society of New South Wales, June 29 -G. H. Cunningham The Gasteromycetes of Australasıa (Part vii.). The genera Disciseda and Abstoma Under Disciseda eight species are placed, one being described as new Under Abstoma are placed two species, one being confined to New Zealand, the other, hitherto undescribed, being confined to Australia (Part viii.) The genus Mycenastrum The single species M cornum is fully described and its great variability indicated —E C. Chisholm. Additional flora of the Comboyne Plateau, 1926.—G H. Hardy. (1) Further notes on a new classification of Australian robberflies (Diptera, Asılıdæ). The whole family Asilidæ is dealt Three subfamilies and seven tribes are recognised. The old subfamily Laphrina is divided, two of the genera being incorporated in the Saropogonini, the remainder forming a new tribe. (2) The phylogeny of some Diptera Brachycera. Tabanoidea, Asiloidea, and Empidoidea are dealt with and special attention is given to the first two. The families Therevidæ, Apioceridæ, and Mydaidæ are closely related to the Saropogonini tribe of the Asılıdæ; also the genus Clesthema, previously regarded as a Therevid, may be an off-shoot from a stock of the Asılıdæ much more primitive than the Saropogonini.

### Official Publications Received.

#### BRITISH

Publications of the British Astronomical Association

Publications of the British Astronomical Association No 58
Tables giving tan, and tan2" in Parabolic Motion, with Argument
M=(t-T)1-1, to facilitate the Computation of Ephemerides from
Parabolic Elements By Bengt Stromgien Pp. 41-57 (London
British Astronomical Association)
The Indian Forest Records Botany Series, Vol 13, Pait 1 Illustrations of Indian Forest Plants By R N Parker Pait i: Five Species
of Dipterocarpus Pp n+30+5 plates (Calcutta Government of
India Central Publication Branch) 1 tupee, 1: Ond
Records of the Indian Museum Vol 29, Part 1 Notes on Lizards in
the Indian Museum, III, On the Unnamed Collection of Lizards of the
Family Scinicide, by Dr Sunder Lal Hora, The Flatishies (Heterosomata) of India, with a List of the Specimens in the Indian Museum, by
J R Norman Pp 47+7 plates 2 tupees Vol 28 Appendix (List
of Literature referring to Indian Zoology (evoluting Insects) received
in Calcutti during the Year 1026) Pp. 25 1 tupee (Calcutta
Zoological Survey of India)
Rugby Engineering Society Proceedings, Session 1025-6 Vol 20
Pp AMI+100 (Rugby) 10s bid
Transactions of the Institution of Chemical Engineers Vol 4, 1926
Pp 209 (London Institution of Chemical Engineers Vol 4, 1926
Pp 209 (London Institution of Chemical Engineers)
Aeronautics Report of the Aeronautical Research Committee for the
Year 1926-27 Pp 55 (London Matiral History and Scientific Society
Vol 10, February 1925 to January 1927 Pp. 52+5 plates (Croydon)
Catalogue of Cases of Birds in the Dyke Road Museum, Brighton
Griffith Fifth edition Pp 290+31 plates+vin (Brighton Brighton
Library, Museums and Fine Arts Committee) 2s tid

#### FOREIGN.

Department of Commerce Bureau of Standards Scientific Papers of the Bureau of Standards, No. 551 Absorption Spectra of Iton, Gobalt and Nickel By W. F. Meggers and F. M. Walters, Jr. Pp. 203-226+2 plates (Washington, D.C. Government Printing Office). 10 cents Proceedings of the United States National Museum. Vol. 71, Art. 14: A new Type of Caddis Case from the Lower Eocene of Tennessee. By Edward W. Berry. (No. 2686.). Pp. 1+1 plate. Vol. 71, Art. 14: Some Peculiar Fossil Forms from Maryland. By Wendell C. Mansheld. (No. 2688.). Pp. 9+5 plates. Vol. 71, Art. 22: A new Nematode, Nematodirus antilocapiae from the Prong-Horn Antelope, with a Key to the Species of Nematodirus. By Emmett. W. Pirce. (No. 2664). Pp. 4+1 plate. Vol. 71, Art. 23: A Fossil Insect from the Lower Permian of the Grand Canyon. By Frank. M. Carpenter. (No. 2664). Pp. 4+1 plate. (Washington, D.C. Government Printing Office).

United States Department of Agriculture. Farmers' Bulletin. No. 1531. The Tobacco Budworm and its Control in the Georgia and Florida Tobacco-growing Region. By A. C. Morgan and F. S. Chamberlam. Pp. 10. 5 cents. Farmers' Bulletin. No. 1533. Rat. Control. By James Silver. Pp. 21. 5 cents. (Washington, D.C. Government Printing Office).

Journal of the College of Agriculture. Holkwado Imperial University.

Office)

Journal of the College of Agriculture, Hokkaido Imperial University,
Sapporo, Japan. Vol 16, Part 5 Studies on Myvospondia of Japan By
Tsinenobu Fujita Pp 220 247+1 plate. Vol 17, Part 4 Chemische
und physiko-chemische Untersuchung des Mannans von Imoghophalis
Konjer Von Suguru Miyake Pp. 163-184 (Sapporo)
Conseil Permanent International pour l'Exploration de la Mei. Rapports et Proces verbaux des Reumons Vol 44 Rapport Atlantique
1926 Par Di. Ed Le Danois et Rafael De Buen Pp. 186 (Copenhague

Andr. Fred. Høst et fils )

### CALALOGUES.

A Catalogue of Books on British and Foreign Birds (No. 490) Pp. 16 (London Francis Edwards) Constable Books Autumn 1927 Pp. 20 (London Constable and Co., Ltd.)

### Diary of Societies.

### CONGRESSES.

ATUJIST 29-SEPTEMBER 3.

INTERNATIONAL COMMISSION FOR THE EXPLORATION OF THE UPPER AIR (at Leipzig).

AUGUST 31-SEPTEMBER 3.

WORLD POPULATION CONFERENCE (at Geneva)

#### AUGUST 31-SEPTEMBER 7.

British Association for the Advancement of Science (at Leeds) BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Lettis)

Filday, September 2, at 10 a M.—Addresses by Sectional Presidents. H
(Anthropology)—Prof. F. G. Parsons. The Englishman of the Future.

—I (Physiology)—Dr. C. G. Douglas: The Development of Human
Physiology—Discussion (Sections A, B): The Nature and Formation
of Colloidal Particles.—Discussion (Section G): Coal—Discussion
(Sections K, M). The Control of Plant Diseases—Discussion (Section
L): Education in Tropical Africa. At 11 a m — Discussion (Section I) - Circulation Rate At 11 80 a m — Address by the President of Section L (Education), Her Grace The Duckess of Atholl - The Broadening of the Outlook in Education

At 8 30 r M - Evening Discourse by Prof. R A. Millikan Cosmic

and Industry — Discussion (Section M) The Production and Distribution of Milk
At \$30 PM — Evening Discourse by Dr. F. A. E. Crew: The Germplasm and its Architecture
Tuesday, September 6, at 10 A.M.—Discussion (Sections C, K, and Cosmical Physics Department of Section A) Climates of the Past.—Discussion (Sections F, J) Innate Differences and Social Status—Discussion (Section L) School Examinations.—Discussion (Section M) Soil Surveys

Surveys
At 3 P M —Conference of Delegates of Corresponding Societies.
Wednesday, September 7, at 12 NOON —Concluding General Meeting.

#### SIPTEMBER 1-1.

Schweizerische Naturorschende Gesellschaft (at Basel) (in 14 Sections), as follow —Medical Biology (Prof R Stachelm, President), Chemisty (Prof H River, President), Physics (Prof P Debyc, President), Geophysics, Meteorology, and Astronomy (Prof. S Mauderl, President), a Mathematics (Prof F Gonsch, President), Pharmacy (J Lang, President), Geology (Prof A Jeannet, President); Mineralogy and Petrography (Prof M. Rheinhard, President); Paleontology (Prof A. Tebler, President), Zoology and Biotmology (Prof A. Reichensperger, President), General Botany (Prof E Wilczek, President), Systematic Botany and Plant Geography, Anthropology and Ethnology (Prof. R. Zeller, President), History of Science and Medicine (Prof. G Senn, President), Presidential Address by Dr F Sarasin —Lectures on, respectively, The Causes and Factors of Morphogenesis, by Prof. A. Brachet, Recent Work and Views in Astronomy, by Prof. L Courvoisier; The Urals from the Point of View of Geophysics, Geology, and Mining, by Prof. I. Dupare, Paracelsus in Relation to Modein Thought, by Prof. II E Sigerist.

#### SEPTEMBER 3-10

International Union of Geodesy and Geophysics (at Prague).

International Union of Geodesy and Geophysics (at Prague).

Empire Mining and Metallungical Congress
Winning Metang, September 3 — G. Cole. The Development of Gold
Mining in Canada — W. A. Quince. Methods of Eliminating Barien
Rock from Ore at the Sub-Nigel Mine — C. R. Davis, J. L. Willey, and
S. E. T. Ewing: Notes on the Operation of the Reduction Plant at
West Springs, Lit.—E. J. Laschinger: A New Formof-Air Meter and
the Measurement of Compressed Air.
Vanciure: Meeting, September: 11—C. P. Browning. Canadian Coppet and
its Production.—F. J. Alcock and T. W. Bingay: Lead and Zine in
Canada.—C. J. N. Jourdan: A Brief Review of the Principal Base
Metal and Base Mineral Resources of the Union of South Africa.—R.
Craib: Dewatering the Lower Levels of the Simmer and Jack Mines,
Ltd.—W. S. Robinson: Manufacture of Sulphuric Acid by the Contact
Process From Zine Blende Roaster Gasos.

Edmonton Meeting, September 20.—R. Strachan, W. J. Dick, and R. J.
Lee. The Coal Industry in Western Canada.—J. Ness: Petroleuin in
Canada.—A. Docquier, L. Bataille, and R. Beetlostone. A Combination of the Baium, the Draper, and the Froth Flotation Systems as
applied to the Washing of Coal at the Linis Mine of the Kailan Mining
Administration, North China.—A. E. Cameron: Impact Resistance of
Steel at Low Temperatures
Quebec Meetings, September 5 and 26.—J. G. Ross. Asbestos Mining and
Milling.—A. W. Nash: Possible Auxiliary Sources of Linguid Fuel.—
A. Job: The Sinking and Equipment of the Ventilation Shaft of the
Government Gold-Mining Areas.—G. W. Sharp. The Tipping and
Guiding of Vertical Skips.—P. M. Newhall and L. Pryce: Improvements in Drilling Efficiency with Jack-Hammers.

Sydney Meetings, September 9 and 10—F. W. Gray: Mining Coal Under
the Sea in Nova Scotia.—Sir Robert Haddield: The Metal Manganese
and its Properies: also, the Production of Ferro-Manganese and its
History.—Raw Materials for the Iron and Steel Industry in India.

B. Yaneske: The Manufacture of Steel in India, by the Duplex

#### SEPTEMBER 4-9.

INTERNATIONAL CONGRESS OF ZOOLOGY (at Budapest).

### SEPTEMBER 6-9.

Institute of Metals (Autumn Meeting) (at Derby).

Tuesday, Neptember 6, at 8 P.M.—Dr. L. Aitchison: Non-Feirous Metals in Modern Transport (Lecture).

Wednesday, September 7, at 10 A M.—Reading of Papers selected from \*

Thursday, September 8, at 10 A M.—Reading of Papers selected from \*

Friday, September 9.—All-day Excursion

Tuday, September 9.—All-day excursion

\*W. T. Cook and W. R. D. Jones. The Copper Magnesium Alloys
Part II —W Hume-Rothery. Researches on Intermetallic Compounds.
VI. The Reaction between Solid Magnesium and Liquid Tin.—K. L.
Meissner: Age-Hardening Tests with Elektron Alloys.—A. R.
Raper: The Equilibrium Diagram of Copper-Tin Alloys containing
from 10 to 25 per cent. of Tin.—C. S. Smith: Note on Cathodic Disintegration as a Method of etching Specimens for Metallography.

H. Sutton and A. J. Sidery. The Protection of Aluminium and its

Alloys against Corrosion—II Sutton and J. W. W. Willstep.—The Nature of the Film produced by Anodic Oxidation of Aluminum—Dr. C. J. Smithells, W. R. Pitkin, and J. W. Avery. Grain Growth in Compressed Metal Powder—Maire L. V. Gayler. The Undercooling of Some Aluminum Alloys—A. G. C. Gwyer and H. W. L. Phillips. The Constitution of Alloys of Aluminum with Silicon and from—F. Hargreaves—Effect of Work and Annealing on the Lead-Tin Eutectic—W. Hume Rothery and S. W. Rowell. The System Magnesium—Cadimium—C. H. M. Jenkins. The Constitution and Physical Properties of Some of the Alloys of Copper, Zinc, and Cadimium

### September 11-17

International Congress of Physics in Commemoration of the Centenary of Volta (at Como)

#### SEPTEMBER 11-18

Informational Congress of Genetics (at Berlin) In three sections General Genetics and Cytology, Heredity in Man and Eugenies, Animal and Plant Breeding

### SEPTEMBER 12-14

INTERNATIONAL SOCIETY OF LEATHER TRADES' CHEMISIS (Bi-Annual Conference) (at Leathersellers' Hall, St. Helen's Place, E C 3

#### September 12 17

SEPTEMBLE 12-17

BRITISH MYCOLOGICAL SOCIETY (Annual Meeting) (at Avienore)

Monday, September 12 - Excursion,
At 8-45 p m — Council Meeting Exhibits

Tuesday, September 13 — Excursion,
At 8-45 p m — Dr. E. J. Butler Presidential Address

Wednesday, September 14 — Excursion
At 8-15 p m — Annual General Meeting,

Thursday, September 15 — Excursion
At 8-45 p m — Dr. M. Wilson, Inte-History of Milesina Kriegeriana and its Occurrence in Britain.— Dr. G. G. Hahn Species of Phomopsis occurring on Confers and their Distinction in Culture,

Finday, September 15.— Excursion.
At 8-45 p.m — Miss M. Wilson. The Dutch Elm Disease.— C. Rea. Remarks on Fungi found during the Foray

Remarks on Fungi found during the Foray

#### SUPIEMBER 15-17.

Annual Conference of Women Engineering (at Shipping, Engineering

Associate Construction of Worker Fractiser is an Supplied, Engineering and Machinery Exhibition)

Thursday, September 15, at 8 g m - Presidential Address at Olympia.

Friday, September 16, at 2 45. - Discussion on the Relative Importance of Commercial and Technical Engineering under Present day Conditions.

Commercial Side Mrss E. M. Kennedy , Technical Side Miss Norah M. Jeans.

Saturday, September 17, at 2.45 (at Croshy Hall). Miss Iris Cummins. Water Power and the Electrification of the Irish Free State.

### SEPTEMBER 18 OCTOBER 3.

International Condress of Theoretical and Applied Limnology (at-Rome). In four sections: Physics and Chemistry, Geology and Hydrography, Biology, and Applied Limnology.

#### **Впртимвии 20 22**

Inon and Steff. Institute (Autum Meeting) (at Royal Technical College, Glasgow), at 10 a m. Papers to be submitted: D. F. Campbell. High-Frequency Induction Melting -H. A. Dickie: Magnetic and other Changes concerned in the Temper-Brittleness of Nickel-Chromum Steels - Prof. C. A. Edwards and K. Kuwada Tho Induced of Cold-Rolling and Subsequent Annealing on the Hardness of Mild Steel. -A. B. Everest, T. H. Turner, and D. Hanson. The Influence of Nickel and Silicon on an Iron Carbon Alloy C. S. Gill: The Effect of Varying Ash in the Coke on Blast Furnace Working -D. Hanson. The Constitution of Silicon Carbon Iron Alloys, and a New Theory of the Cast Irons --E. G. Herbert: The Work-Hardening of Steel by Abrasion --K. Honda and K. Takahasi. On the Quantitative Measurement of the Cutting Power of Cuttery. E. H. Lewis. The Use of Silica Gel as a Medium for Drying Blast. T. Matsushida and K. Nagasawa. The Mechanism of Tempering of Steels. -T. W. Robinson. The Economic and Social Development of the American Iron and Steel Industry.-Dr. W. Rosenham and D. Hanson. The Behaviour of Mild Steel under Prolonged Stress at 300° C. J. H. Smith and F. V. Warnock: A Testing Machine for Repeated Impact, and a Preliminary Investigation on the Effects of Repeated Impact, and the Precipitation.-F. Wust. A Contribution to the Theory of the Blast-Furnace Process.

#### SEPTEMBER 23-26.

SEPTEMBER 23-26.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at Trinity College, Cambridge).—Subjects for discussion: Report of the Public Libraries Committee of the Board of Education (A. R. Twentyman and Lieut-Col. L. Newcombe); Recent bevelopments in connexion with the Science Library, South Kensington (Sir Henry Lyois); Information, Organisation, and Statistics in Industry (Major L. Urwick, S. J. Nightingale, H. Quigley, W. Wallace, A. E. Overton, F. W. Tattersall); Patent Classification (A. R. Wright, A. Gomme); Problems of the Information Bureau (A. F. Ridley, P. K. Turner, Dr. J. C. Witters); Photographic Reproduction of Printed and Ms. Material (N. Parley, Sir William Schooling, R. H. New); Standards of Book Selection in Science and Technology (Sir Richard Gregory).



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No. 3019, Vol. 120]

### Biology and the Race.

THE presidential address to the South African Association for the Advancement of Science, delivered by Prof. H. B. Fantham at Salisbury on June 29, deserves perusal by all interested in the broader problems of biology in its relation to national polity. There are probably few biologists who will regard as unjustified the note of pessimism which makes itself heard here and there in the address: there are equally few who will fail to recognise its common sense and constructive value, or to admit that much of what is addressed to South African listeners is well worthy of attention in Great Britain.

Dealing first with the immense spread of education in western Europe and America during the last six or seven decades, Prof Fantham asks, Has it fulfilled its expectations? This question must be answered in the negative, not, however, that education is itself at fault, but rather that the swarming into the universities of all and sundry m search of a vocational training has brought with it the development of the examination system with its resultant overwhelming of the truly educative by the merely informative function. Initiative, instead of being developed, has been diminished or killed, and the universities, from being the homes of culture and the training-grounds of leadership, have tended to become mere trainingcolleges for the professions. The universities in turn react upon the schools owing to prospective teachers concentrating their attention upon such subjects as, at the moment, 'pay.' During training in the technique of teaching due attention is paid to drill in the 'principles' of education and psychology, but little to the fact that without solid biological foundations such principles are liable to be no more than the fleeting fads and hypotheses of the day. The teacher is told to 'follow the child': to make study interesting instead of to make the pupil interested in study. He is unimpressed by the important need to make the child fit into his biological environment by attention to the so-called small things of life—politeness, tidiness, consideration for others, the team spirit, the avoidance of sloppiness-mental, moral, or physical.

The instilment of biological principles into the school curriculum means the development of common sense, the appreciation of cause and effect, the development of personal effort, personal observation, personal thinking—all as different as possible from the familiar product of the present

day with its absorptiveness of what is served up to it, its responsiveness to popular catchwords and slogans, and its belief in conferences and committees.

No section of Prof. Fantham's address is more deserving of serious consideration than that in which he directs his attention to some of the sociological difficulties of the day. He points out the impossible handicap to which the white race is submitting itself by the ever-growing burden of social services with their crowds of officials. Amongst the most costly of these services is school education, but this burden is not incapable of being 'Frill subjects and snippets' should lightened be eliminated or paid for by the parent. It is suggested that the education provided free by the State should be restricted to 'the three R's,' the study of the mother tongue—including grammar and composition, the general elements of observational and experimental science, with needlework and cookery for girls, together with a cultural subject, such as singing. Secondary education should not be free—it is a curious human weakness that what is not paid for is not appreciated—but generous help should be available in the way of scholarships to those who are mentally qualified to take full advantage of them.

It is perhaps prudent to hesitate before we dismiss all this as old-fashioned, and to ask ourselves seriously whether there is not contained in it a very large infusion of common sense.

Prof. Fantham, being a distinguished South African biologist, we naturally turn with special interest to what he has to say on the colour problem, for there are few problems in which attempts to reach a true solution have been more interfered with by the intrusion of sentiment uncontrolled by scientific knowledge. Here we have the opinion of a biologist who realises, as all biologists do, that the black skin of the negro is the outward expression of profound differences of a more obscure kind, which mark him off from the white race as distinctly as does his non-attainment of what we call civilisation, with its complex social organisation, its great cities, its high art, its written language, during all these untold centuries of his undisturbed sojourn in Africa.

Prof. Fantham has no doubt that the proper line of policy is that of social segregation of the two races. Racial admixture is disastrous in its results. "When once chromosomes of Bantu origin get mingled in white families they cannot be bred out, as is so often popularly supposed, but will exhibit themselves in unfortunate ways

and at unfortunate times throughout the ages. What we have to do is to make the black man a happier and better black man, not to attempt to make him an imitation white man. He is a country man. He should be settled in the country and trained in practical agriculture, in hygiene and sanitation. He should not be brought into towns and made to do all the manual labour of the whites—with the resultant encouragement of sloth and idleness amongst them.

It will be seen that Prof. Fantham's address deals with matters that have been much in the air As the columns of Nature have at the moment repeatedly testified during the last few months, the rôle of science in the school education of the citizen is attracting at the present time much attention and giving rise to much discussion. Not infrequently in the course of such discussion the main issue tends to be obscured through the persistent failure to keep distinct in the mind the two main functions of education—the first in importance, as it is in time, that of educating in the strict sense, of developing to the highest possible extent all these various capacities which combine to produce all-round ability, such as accuracy and rapidity in observation and the accumulation of experience, involving on one hand skill in actual observation, and on the other, skill in drawing rapidly and accurately sound conclusions therefrom; and the second, that of providing the mind with a store of knowledge and Although the boundary between these two functions of education is naturally not a sharp one, it is imperative in order to secure clarity of discussion that its existence should not be ignored.

As a matter of fact the educational utility of the two main branches of science - physical on one hand and biological on the other- is related to these two main functions of education. As a discipline for the young child, to develop the powers of observation and of reasoning upon the basis of observation, it would appear unquestionable that it is the physical division of science that is the more useful. By it alone are provided those simple types of observation, capable of exact measurement and of repetition over and over again under approximately the same set of conditions, which are necessary for the best training in observational accuracy. Moreover, the mathematical methods employed in the treatment of its observations afford a quite unrivalled training in logical reasoning.

It is, on the other hand, in the later task of school education, that of turning out the wellinformed citizen, that the claims of biology to play an important part are quite irrefutable. In a complex modern State, with its citizens linked together into a biological whole of the greatest complexity, depending for its continued existence upon the applications of biology to food-supply, sanitation, medicine, surgery—its everyday discussions and conversations dealing with subjects like evolution, genetics, birth-control, heredity, public health, and so on—it is clearly absurd that the citizen should not be provided with the foundation of biology without which such discussion is apt to be not merely futile but actually harmful.

While probably all qualified by their own experience to form an opinion will be in agreement up to this point, there is unfortunately up to the present no agreed scheme of instruction in elementary biology for schools. The best of such courses as do exist in a few of the great public schools are commonly modelled upon what is required for the first MB examination. Even for its own special end—that of providing a sound foundation of scientific biology for the superstructure of the medical curriculum—this type of course is looked at askance by many competent judges, but quite certainly it is not what is required by our ordinary budding citizens What is required for the education of the general citizen is not a mass of details regarding the 'insides' of men, or rabbits, or crayfish; it is not a collection of packets of ignorance or very incomplete knowledge done up in wrappings of polysyllabic words; it is rather a general knowledge of such of the main developments of biological science as are of importance, either practical or cultural, in the citizenship of the civilised State.

Each of the two main branches, then, of science the physical and the biological—has its own rôle to play in elementary education, and it is of the greatest importance to realise this. It is of equal importance to realise what is wanted from each branch. In neither case is it masses of complicated detail. In the case of physical science, it is the careful repetition of observation and experiment in their simplest forms and the recording and treatment of the results arithmetically, the object being to train the young child in accuracy and rapidity of observation and reasoning. In the case of biological science, it is the acquirement of general knowledge regarding main results rather than training in the method of obtaining these results that is required by the citizen.

While the physicist may justly claim upon this showing that it is physical science that plays the more fundamental part in the educative process,

in actual practice the recognition of this claim has led to strange results, namely, on one hand the denial to biological science of any place in the school curriculum at all, and on the other, to that hypertrophy of the physical science portion of the curriculum which finds its expression in the schools undertaking courses in chemistry of a standard which is really that of the university It is a common complaint, as already noticed in NATURE, that students of science and medicine in our universities have to waste an appreciable part of their time at the university in repeating what they have already done at school The harm is much more than mere waste of time, for the quality of instruction in the average school laboratory is obviously not in a position to claim equality with that of a university department under the inspiring headship of a leader in his science

When complaint is made of the large and even preponderating part played by science in certain modern developments of our educational system, it is well to bear in mind that 'science' in this connexion is apt to mean simply physics or chemistry. As stated in Nature of Aug 13, of the candidates from grant-aided secondary schools in England in the First School Examination in the year 1926, no less than 402 per cent. offered chemistry as a subject but only 2.5 per cent. offered general science While overwhelming arguments can be adduced for science on the lines above indicated being given an important place in the school training of the average citizen, it is difficult to find any justification at all for bringing him up as a specialist in physics and chemistry completely unversed in science outside their limits.

Royal commissions are commonly regarded as the resort of harassed politicians when seeking a means of relieving some inconvenient form of public pressure But occasionally they achieve great results, and the present would seem a really appropriate time for the appointment of a strong commission to deal with the general question of national education. When such a commission is appointed it is to be hoped that its personnel will consist not of academic specialists, but rather of persons who combine recognised intellectual prestige with understanding and breadth of vision, and that its terms of reference will be as wide as possible so as to include the whole range of education from the elementary school to the university. The selection of the personnel should provide a means of securing that its activities would be confined to big things and not wander away into the desert of detail.

# Réaumur and his Work on Ants.

The Natural History of Ants from an Unpublished Manuscript in the Archives of the Academy of Sciences of Paris By René Antoine Ferchault de Réaumur. Translated and annotated by Prof. W. M Wheeler. Pp xvii + 280 + 4 plates. (New York and London. Alfred A. Knopf, 1926.) 25s

DENÉ ANTOINE FERCHAULT, Seigneur de Réaumur, was born at La Rochelle in 1683. After a short course of training in the law, he devoted himself to the serious study of mathematics, and at the age of twenty-four years was admitted a member of the Academy of Sciences. His life for the next fifty years was one of constant application to scientific research in the departments of physics, metallurgy, crystallography, and meteorology, as well as natural history. His work included experiments on torsion, on the ductility of metals, on the manufacture of steel, of tin-plate, and of porcelain. In physics he investigated the temperature of mixtures, and devised the scale which long remained the prevailing system of thermometric graduation on the Continent.

Réaumur's chief interest, however, lay in natural history, and his achievements both in observation and experiment were truly remarkable. He was the first to describe the ambulacra of starfishes, and to him were due the first systematic observations on the reproduction of cast limbs in the Crustacea, which he attributed to the presence of minute living particles, called by him petits œufs. The physiology of digestion engaged his attention, and some well-devised experiments enabled him to demonstrate the action of gastric juice upon proteid foodstuffs. But the object towards which his efforts were mainly directed was the study of the instincts, life-history, and general behaviour of insects; and it is on his writings in this department of research that his reputation among present naturalists chiefly rests.

The volume before us contains a careful transcription of the hitherto unpublished "Histoire des fourmis," which was apparently intended to form part of the seventh volume of Réaumur's "Mémoires pour servir à l'histoire des insectes," of which six volumes were issued between 1734 and 1742. To the original text, Prof. W. M. Wheeler has added an excellent translation and a series of valuable annotations. In these he has performed the useful task of giving at length many passages of other authors to which Réaumur refers, and the still more meritorious office of interpreting and

correcting Réaumur's statements in the light of present knowledge. It may perhaps be remarked in passing that it would be well if some competent person were to render a like service to the biological It was searcely to be extreatises of Aristotle pected that the pioneer work even of so shrewd and capable an observer as Réaumur should be free from errors of faulty inference, arising partly from limited opportunities and partly from imperfection of the optical means at his disposal He was the first to observe the fact that ants ascend trees for the purpose of feeding on exudations furnished by aphides and scale-insects, but it is not surprising that his account contains one or two inaccuracies. So, too, the microscopic technique of his day did not enable him to recognise that the workers were not really sexless, but were normally sterile females.

To Réaumur is due what is perhaps the earliest experiment in phototropism. He also was probably the first to observe recently fecundated females in the act of founding colonies. Gould, to whom the original observation of this proceeding is commonly attributed, did not publish his account until 1747, whereas Réaumur's must have been written (though not published) before 1743. The same remark applies to Réaumur's discovery of the feeding of larvæ by liquid disgorged by the workers; also described by Gould in 1747. Another of Réaumur's records contains the first account of mutual feeding among ants; and yet another, only recently verified, deals with the facilities provided by the workers for the larvæ in the act of spinning their cocoons. Experiments were started by him with the object of ascertaining whether ants would tolerate the presence of larvæ belonging to an alien These experiments, however, apcommunity. parently did not extend beyond the limits of the same species.

In all Réaumur's work, painstaking and thorough as it was, it is curious to recognise that systematic zoology made little or no appeal to him. His interest lay almost entirely in observation and experiment on insect behaviour, scarcely at all in insect morphology. Classification in his day was in its infancy, and we need not be surprised that he draws no distinction between ants and termites. But when we find him saying, "It seems to me that the many hundreds and hundreds of species of gnats and very small moths which exhibit nothing more remarkable than a few slight differences in the form of the wings or the legs, or varieties of coloration or of different patterns of the same colours, may be left confounded with one

another," we cannot but realise how widely his point of view differs from that of the modern zoologist.

Still more startling, as Prof. Wheeler says, "is his conception of the insects as a natural class, since, like other naturalists of his day, he not only included in it the worms, polyps, mollusks, arachnids, myriopods, and crustaceans, but also the reptiles." The limit is perhaps reached in his remark. 'The crocodile is certainly a fierce insect, but I am not in the least disturbed about calling it one." Laxity of this kind was not likely to commend itself to Cuvier, in whose article in the "Biographie universelle," mainly eulogistic, it is possible to discern a certain coolness in regard to Réaumur's merits as a naturalist Not much sympathy was to be expected between men whose temperaments and methods differed so widely as those of Réaumur and Buffon, and as a matter of There is, however, no sufficient fact none existed reason for supposing that the non-publication of the concluding volumes of the "Mémoires" was due to an intrigue set going by Réaumur's formidable rival.

Prof. Wheeler's book is well printed and well produced. It will be of great value to all those who are interested in the historical stages of our acquaintance with the habits and life-history of the remarkable insects of which it treats

F. A. D.

## Metalliferous Mining Methods.

The Working of Unstratified Mineral Deposits. By George J. Young. With a Chapter on The Hæmatite Ores of Cumberland and Furness, by T. S. Durham. (Benn's Mining Series.) Pp. 466+12 plates. (London: Ernest Benn, Ltd., 1927.) 42s. net

THIS volume forms the second of a series of works dealing with the various phases of mining which is being produced by Messrs. Benn, Ltd., under the general editorship of Prof. Henry Louis. To quote the editor's introduction, "There is probably no industry that depends upon so great a variety of other arts and that involves so many branches of science as does mining, nor one that includes such a complexity of operations." The most important of all the phases is the winning and working, or extraction of the deposit.

Mineral deposits, broadly speaking, can be divided into two divisions, namely, unstratified and stratified, the former being essentially metalliferous, and the latter largely coal and stratified ironstone and such deposits as the Rand goldfield.

The subject of extraction is so wide and varied that the editor of the series has wisely decided to treat it in two volumes and this volume deals essentially with the working of unstratified deposits. The remaining volumes of the series are being written by British mining engineers, but the author of this particular volume is a well-known American. As the United States of America is the largest metal-mining country in the world at the present time, the choice of the author is a wise one, as he has been able to draw upon the accumulated knowledge of his own country to furnish examples and descriptions of the methods of working every conceivable type of deposit. The book is therefore very largely a manual of American practice There is, in addition, at the end of the book, a short chapter by T. S. Durham describing the methods of working the hæmatite ores of Cumberland and Furness

The book can be divided into four parts, namely, a general consideration of mining methods and mineral deposits, followed by the three main chapters dealing with narrow, wide, and large ore bodies respectively

The chapter on ore deposits refrains from any comments on the genesis of such deposits, but discusses generally their practical features, such as their varying shape, size, depth, physical characteristics, the effect of the enclosing walls and the behaviour of the surrounding earth masses during and after excavation

In many deposits the line of demarcation between the suitability of open cast and underground methods of working is indefinite. It is quite impossible to lay down any law on the subject, and no attempt is made to do so

The chapter on mining methods is good and comprises two main features; first, a description of the various forms of supports used in underground mining and the conditions under which they may be used advantageously or must of necessity be adopted. The merits of timber supports, the permanent filling of the excavation with waste rock, and the use of broken ore as a temporary support are fully discussed. The second portion of the chapter deals with the many variations of three simple methods of working which are characterised by the line of advance of the working faces, namely, upwards, downwards, or horizontally. One of these three methods, combined with the materials used for supporting the excavation, constitutes the system of working employed to excavate any given deposit.

One of the particular features of this book is the

attention paid to the methods employed for working large low-grade deposits upon which the modern mining industry has largely to rely owing to the small comparatively rich deposits of the nineteenth century becoming exhausted. This necessitates the handling of large quantities of material, and many of the methods of working described in detail have been devised for this purpose. When dealing with large quantities small economies make all the difference between profit and loss, and attention is directed to points where saving can be effected.

The selection of a mining method is based primarily on its suitability for the physical conditions of the ore body and upon the cost comparison of different methods that may be applicable under the given conditions. Costs are expressed in terms of labour and materials, sometimes graphically and sometimes in tabulated form. This will enable engineers in other parts of the world to compare the working costs of their own mines with those given by the author for alternative methods.

In the three chapters dealing specifically with ore bodies of various sizes—a narrow size being one less than 12 feet thick, while the subdivision of the remainder into wide and large ore bodies allows for a very elastic treatment—the author discusses the characteristics of such deposits and then proceeds to show how variations in their characteristics affect the method of working. This entails primarily a general statement of the principles involved and is followed up by detailed descriptions of the application of these principles. Many examples of successful application are given, and it is in these chapters that the author's wide experience of American metalliferous mines is displayed at its best.

In mining unstratified deposits, no general law as to the method of working to be adopted can be laid down. Each individual case has to be decided on its merits, and the decision is further complicated by the uncertainty which always exists as to the size, shape, and future value of the deposit. Knowing this, stress is laid upon the necessity for development work and the provision of ample 'ore in sight.' The numerical value of the 'development ratio' is not, however, fully discussed.

When it is realised that metal mines are being worked at deeper levels every year, and that one of the determining factors in the successful operation of deep, and therefore hot, mines is the comfort of the workers, more space might have been allotted to the necessity for an ample flow of cool dry air round the working faces. The provision of adequate ventilation is intimately bound up with the method of working employed.

The book is bulky, being printed on thick paper, and, at the same time, loosely bound. As it should find a place in the library of all metalliferous mining engineers, whose sphere of work is often far from modern means of transport, it might well have been compressed into a smaller and stronger volume. The print is large and easy to read, and the illustrations, many of which have been specially prepared for this volume, are excellent. It is the most complete work dealing with the mining of unstratified minerals yet published.

# The Egyptian God of Medicine.

Imhotep: the Vizier and Physician of King Zoser and afterwards the Egyptian God of Medicine
By Dr. Jamieson B. Hurry. Pp. xvi + 118 + 13 plates. (London: Oxford University Press, 1926.) 7s. 6d. net.

TITHE author of this volume, himself a doctor of medicine, is inclined to chide the medical profession for neglecting its true patron saint, who was in practice more than two thousand years before either Hippocrates or Galen - It is doubtless partly to help Imhotep to his own that Dr. Hurry has written the present book. It is, as it could not but be, based on Sethe's masterly memoir on the same subject written twenty-four years ago. There is not much to be added to this Sethe's work does not age rapidly -but what there is Dr Hurry has found and added The most striking additions are the Nechautis Papyrus from Oxy rhynchus, which, if its story could be trusted, would put back the full deification of Imhotep by 2000 years, Gauthier's article on the Imhotep festival, and Milne's on the graffiti in the Sanatorium of Der el-Bahrî. We are at a loss, however, to understand why he has completely ignored the account of King Zoser given by both the epitomisers of Manetho the Egyptian historian, which, if Sethe's elever and convincing conjecture be correct, is a description of Imhotep himself.

Imhotep was an Egyptian Leonardo da Vinciarchitect, writer, and physician in one. Though the discoveries at Saqqara during the last two winters have shown that his achievements in building must have been very considerable, it is as a doctor that he survived in the memory of the Egyptians. How soon he became what Dr. Hurry

describes as a "medical demigod" we cannot say. probably shortly after his death. In this stage he remained, if we hesitate to accept the evidence of the papyrus mentioned above, until the Persian period, about 525 BC, when he first appears with the full attributes of a god. These developments in his status Dr. Hurry describes very clearly and with due regard for the value of various types of evidence. Both here and in the all too short chapter on Egyptian medicine, he shows a happy ability to clothe an ingenious conceit in a neat garb, and this makes his book very readable

A few small points, mostly lying outside the main line of the argument, call for remark Hurry has been a little unfortunate in his authorities on some points connected with Egyptian belief Thus the Liturgy of the Funerary Offerings did not aim at changing the offerings into "a divine and spiritual food, which was partaken of by the souls of the departed" (p 13). One of the most certain things about Egyptian belief is that the dead were envisaged as still physically living, though perhaps in a slightly different sense from that in which they had lived here Hence the need for mummification to preserve the body, and the terror lest this should be destroyed. This physical body needed physical food, and that is precisely what was given to it. A similar error appears on p 64, where Dr Hurry states that what persists after death is the ka or double, and that it is this 'part' of a man which needs the nourishment. What eats the food is in reality no ku, but the dead man himself. For such mistakes the Egyptologists and not Dr. Hurry are to blame. On p 15 we read that the Kheri-heb priest was "by the common people . . regarded as the mediator between the King and the unseen powers of the universe" Such an idea is totally un-Egyptian. In Egyptian religion the king is in theory the only priest, and the whole funerary ritual is performed by him as the incarnation of Horus for the dead person conceived as Horus's dead father Osiris There can be no mediator between the king and the gods or the dead.

On p 77 we find the curious remark, "More complicated operations were performed on the domestic animals than on man." This is a most interesting example of how errors arise. In the tale of King Khufu and the magician Dedi (Papyrus Westcar) the king wishes to see Dedi perform his vaunted trick of cutting off a head and fastening it on again, and commands a prisoner to be brought for this purpose. The following sentence is obscure, but it would seem

that Dedi suggests making his experiment not on a human being but on one of the domestic animals. This I take to be the origin of Dr. Hurry's statement: at least I can find no other.

In Appendix B, on the name Imhotep, the author has been dogged by ill luck. The transliteration IJ-m-htp is a purely German form, the German J representing our consonantal J Read therefore Iy-m-htp. Secondly, the verb htp means not 'to satisfy,' but, intransitively, 'to be content' Thirdly, there is no 'particle' m meaning 'as' or 'm the guise of'; this m is precisely the preposition meaning literally 'in' of which Dr Hurry has just been speaking. Fourthly, though it is not grammatically impossible that the element IJ should be the imperative, yet the rarrity of this form and the absence of variants of the name showing the much more common form Mi make it unlikely.

In conclusion, I hope that Dr Hurry's conception of the high standard of Egyptian hygiene is a true one, but I cannot help feeling that if he had excavated, as I have, an Egyptian city, he would have misgivings

T. E. Peet.

# The Vegetation of the British Empire.

Aims and Methods in the Study of Vegetation.
Edited by Prof. A. G. Tansley and Dr. T. F
Chipp. (Published by the British Empire
Vegetation Committee) Pp xvi + 383 + 19
plates. (London: The Crown Agents for the
Colonies, 1926) 12s 6d

WING to the foresight and mutiative of Sir Joseph Hooker, we now possess published floras of many of the British colonies, but such floristic data is only the pioneer work which should form the basis for further research The time has now come when the investigation of the vegetation of the Empire can be profitably undertaken, and indeed urgently demands attention. Quite apart from the value of such knowledge for its own sake, an ecological survey of the Empire is of paramount importance for its further economic development. To exploit the natural vegetation of any region to the best advantage, we require to know much not only with respect to its existing composition and structure, but also its potentialities under the more or less artificial conditions imposed by man.

The British Empire Vegetation Committee appointed by the Imperial Botanical Conference in 1924 in furtherance of these aims has published the volume before us. The first section comprises a brief account of the nature of plant communities,

the method of their investigation and the factors of the habitat, whilst the remainder is in the nature of a symposium of essays by different authors which, though often overlapping, have their chief value in the diverse viewpoints which they present, with consequent diversities of technique and emphasis. Moreover, many useful practical hints are furnished for the investigation of the respective areas dealt with. Of especial interest are the sections on the ecology of fungi and lichens by Mr. Ramsbottom.

Perusal of these pages emphasises the need in vegetation studies for accurate empirical descriptions unbiassed by any theory which attempts to fit the communities observed into a hypothetical succession series or to find their equivalence with communities in other areas which have been investigated on different lines Too rigid a uniformity is much to be deprecated, but if the attempts at classification of plant communities are to be rescued from their present somewhat chaotic condition, it is essential that the various aspects of the community and habitat alike should be studied. At present we know much concerning the soil conditions in the communities of one region, of the putative successions in another, of the physiognomy or the biological relations in a third. Each of these lines of investigation has, indeed, at one time or another, served as the basis of a more or less exclusive classification, but if the pages of this volume serve no other purpose than to bring about a wider and more uniform basis of investigation of the communities within the Empire, the task of the synecologist of the future will be appreciably diminished.

How important, from the economic viewpoint, is a knowledge of the plant communities and the successions of any area, is shown by the changes which fire protection has wrought in India, to which Prof. Troup directs attention in his suggestive survey of Indian forest vegetation. Such protection has not only resulted in replacement of grassland by forest, but has also produced profound changes in the composition of the forest itself. The widespread effect of the shifting cultivation practised in the tropics is emphasised by several of the contributors. To this cause both Prof Troup and Dr. Stamp attribute many of the grassland areas and bamboo thickets in the forest regions of India and Burma, whilst the same factor is held by Dr. Chipp as initially responsible for the forest retreat in West Africa. Prof. Bews shows how a study of the successions in the grass communities of South Africa has both explained

the conflicting views respecting the value of burning and supplied the criteria for ensuring the appropriate and successful use of this method.

It cannot, however, be too strongly urged that if the fullest use is to be made of ecological methods for the solution of economic problems, it is essential that the study of vegetation should be accompanied by a parallel study of the animal ecology. The valuable conclusions arrived at by Dr. Cockayne in his studies of palatability in the tussock grasslands of New Zealand, have shown how profound an effect the selective action of grazing animals may produce, whilst the thickets of Zizyphus anophia in the Central Provinces or the spread of Opuntia incrimis in Australia serve but to show that man is not alone in upsetting the balance of Nature to the detriment of his environment.

E. J. Salisbury.

#### Our Bookshelf.

The Music of the Spheres. a Nature Lover's Astronomy. By Florence Armstrong Grondal. Pp. xiii+334 (24 plates). (New York. The Macmillan Co., 1927.) 21s. net.

THE author has collected a large number of myths and poetical references associated with the heavenly bodies, and has woven them into a discursive description of the stars in their constellations and of the members of the solar system. The first ten chapters are replete with legends by which the more spectacular stellar objects (bright stars, double stars, clusters, and nebulæ) may be remembered. The remaining seven chapters are descriptive of the sun and its satellite members of the solar system, an interesting perspective of the geological processes through which our planet has passed is given in one of these chapters. Simple language and illustrations are employed generally, but a few terms such as 'spectroscope,' 'seconds' (of arc) might have been explained. A brief description of a refracting and a reflecting telescope is left to the final paragraphs, which contrast unfavourably with the opening sentences of the book. Occasionally accuracy of statement is sacrificed for rhetoric—the sun's corona is described as 'flaming,' and prominences are spoken of as 'burning gases' The sentences on p 12 concerning the measurement of the sun's diameter and those of only four or five of the stars convey a wrong impression of astronomical measurement. A mis-statement appears on p. 74, where the distance of the Andromeda nebula is given as 36,000 light years instead of one million Incidentally, the quotation on p. 76 is from Keats, not Longfellow.

With slight exception, the reproductions of photographs are admirable and make a very attractive feature of the book: a few star charts (coloured for preference) showing the whole heavens would, however, have assisted the reader

in linking up the many constellation diagrams, a few of which appear somewhat redundant. Finally, it should be remarked that the volume is essentially a gift-book, with its large print, heavy paper, and choice reproductions, and it will be unfortunate if its cost should deter any one from possessing a copy or placing one in the hands of a friend

Handbuch der biologischen Arbeitsmethoden Herausgegeben von Prof. Dr. Emil Abderhalden Lieferung 220 Abt 11 Chemische, physikalische und physikalisch-chemische Methoden zur Untersuchung des Bodens und der Pflanze, Teil 3, Heft 5. Ernahrung und Stoffwechsel der Pflanzen. Methoden der mikrobiologischen Bodenforschung Von Selman A Waksman Pp. 715-864. (Berlin und Wien: Urban und Schwarzenberg, 1927) 7 20 gold marks.

The study of the activities of soil micro-organisms is of comparatively recent origin, and consequently the methods employed for such researches are not well known, and in many cases have not attained the degree of standardisation necessary for comparative investigations. This is particularly the case with regard to the numerous methods employed for counting the numbers of soil bacteria, protozoa, fungi, or algae, and for estimating the degree of activity of such members of the soil population The present part of Abderhalden's "Handbuch" should prove exceedingly useful to soil investigators. S. A. Waksman has acted as general editor and has contributed the mycology and bacteriology sections, with the exception of that on cellulose decomposition, which is written by Chr. Barthel of The technique used in the study of Stockholm soil algae and protozoa is described by B M Bristol-Roach and D. W. Cutler respectively.

With a subject growing so rapidly as soil microbiology, any book is to a certain extent out-of-date before it is published, and though doubtless certain sections of the present part of "Abderhalden" would be slightly altered if rewritten, yet it can be safely recommended as the most up-to-date work on the

Grundriss der Kriminalbiologie: Werden und Wesen der Personlichkeit des Taters nach Untersuchur\_n an Straflingen. Von Prof. Dr. Adolf Lens. Pp. vii + 252. (Wien . Julius Springer, 1927.) 15 gold marks

DR LENZ, as director of the University Criminological Institute of Graz, is well fitted to describe to us the influence of the personality on criminals, and in this book he does this in an extremely able manner. His case material consists of criminals from the prison at Graz and the Petty Assize prisons in Vienna and Graz. He regards crime as the resultant of the interaction of personality and its environment. In the personality he includes the physical structure as well as the psychical, and in this is following much the same lines as Kretchmer does in his well-known "Korperbau und Charakter."

The author divides his book into four parts. The first part deals with his method of investigation and

the nature and problems of criminal biology The second part is concerned with the nature and development of personality, the importance of symbolism and the reaction of the personality to its environment. In the third part, the actual crime and its relation to the personality and its environment are considered. The fourth part deals with the sensory, intellectual, and volitional tendencies, the structure of the ego, and the relation of crime to the sex and herd instincts.

Graphit: Charakterıstık, Erzeugung, Verarbeitung und Verwendung Von Dr Eugen Ryschkewitsch. (Chemie und Technik der Gegenwart, Band 7.) Pp xii+323 (Leipzig S. Hirzel, 1926.) 14 50 gold marks

This monograph is an interesting and well-printed volume, commendable for good arrangement of the subject matter. Though the author admits that his sources of reference are limited, he offers much up-to-date information, giving considerable attention to a detailed description of the chemical, physical, crystallographic, and mineralogical characteristics of graphite; this is invaluable alike to student, manufacturer, and consumer. The dressing and refining of the material are dealt with m a more cursory manner than is usual m books on this subject, but the writer nevertheless indicates the fundamental principles of preparation in a lucid manner. There are also some interesting chapters on the distribution of the raw material and its origin in Nature, on the artificial formation of graphite, on industrial applications, and on commercial statistics; in the last, the author's criticism of certain figures published by the Imperial Mineral Resources Bureau is noteworthy, as it indicates that he does not quote even supposedly reputable information without duly pondering on its value. The book may be considered an asset to a scientific or technological library.

The Nature of Man. By Dr. G. A. Dorsey. Pp. viii + 104. (London: Harper and Bros., 1927.) 3s. 6d. net.

In this little book Dr. Dorsey has in mind the practical and immediate application of the scientific study of man. "Everything said in this book may be taken personally," he says, in his opening chapter, and his concluding words are: "Nothing is known of God's will; enough is known of Nature to point the way Man must travel if he is to survive and the goal he must desire to make the most of his nature." Dr Dorsey's method of attacking the problem is by an exposition of man's nature and activities as an individual and as a member of family and other social groups upon a purely mechanistic basis. The mind, the soul, the group mind, the herd instinct, in short, the whole of the material of the psychologist, as well as his terminology, disappear in favour of what science 'knows'-visceral behaviour, genetic behaviour, somatic behaviour, social behaviour, and cultural behaviour. Dr. Dorsey's little book is an aid to clear thinking, even if his readers will not be prepared to go the whole way with him.

subject.

## Letters to the Editor.

[The Editor does not hold lumself responsible for opinions expressed by his correspondents. Neither can be undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. No notice is taken of anonymous communications.]

#### Structure in Surfaces of Liquids.

Mr. Hatschek, in his interesting article in Nature of June 11, p. 857, has shown that colloidal solutions and even the simplest suspensions of solid particles in liquids exhibit a property which is absent from all true liquids; namely, residual rigidity, or at least a coefficient of viscosity that depends upon the rate of shear. He has advanced no explanation of this remarkable result, which would, however, appear to be just one manifestation of a general property of all

surfaces involving liquids

In an address delivered by me before the Mid-West Regional Meeting of the American Chemical Society at Madison in June 1926 (since communicated for publication in the Journal of the American Chemical Society), absolute measurements of the adsorption of such substances as p-toludine in the surfaces of their aqueous solutions were adduced, which made it eyident that the excess of dissolved substance in the surface is several times greater than that which can be close-packed as a monomolecular film resting upon the surface. This demonstrates that the surface of a liquid possesses a depth which is considerable as compared with the diameter of a molecule, and the obvious inference was drawn that chains of oriented molecules of dissolved substance extend inwards into the solution until they are broken up through thermal The usual structure of the surface even of pure liquids would appear to be a single complete layer of oriented molecules with numerous unstable chains of oriented molecules extending therefrom into the liquid. It is evident that this hypothesis predicts a quasi-rigidity in the neighbourhood of all surfaces bounding a liquid, and suffices to explain the facts mentioned by Mr. Hatschek.

Evidence for the truth of this hypothesis is to be found in many fields. For example, in numerous experiments upon adhesion and adhesives, whether with pure substances or mixtures, liquid or solidified, we have always found "the thinner the film, the stronger the joint," the effect increasing most rapidly when the thickness of the layer under investigation is reduced to the order of a millionth of an inch. It likewise serves to explain the considerable effective range of molecular attraction without involving more than direct action of molecules upon others with which they are immediately in contact. Another illustration is given by the effect of finely divided fillers' such as carbon upon the strength and resiliency of rubber tyres or by the effect of oil upon troubled water. It is gratifying to find that recently Sir William Hardy (Jour. Gen. Physiol., 8, 641; 1927) has come to similar conclusions from experiments on

lubrication

In an article in the Journal of Physical Chemistry (30, 239-247; 1926), I put forward as a general explanation of the high apparent viscosity of many colloidal solutions the tendency of colloidal particles to aggregate into larger secondary structures ramifying through or partially enclosing large tracts of solution that are thereby effectively immobilised Mr. Hatschek (J. Phys. Chem., 31, 383-392; 1927) has attacked this quite general hypothesis, which includes many special cases, in favour of one single form of it. It seems preferable to retain the more general and inclusive

view. Whatever form of ramitying aggregate is present in a colloidal solution, the surfaces of the colloidal particles will be surrounded by chains of oriented or linked molecules extending towards each other and thereby imparting far greater effective rigidity and apparent viscosity than could be produced by the colloidal particles or aggregates themselves.

JAMES W MCBAIN.

Department of Chemistry, Stantord University, California, Aug. 11

#### The Production of Sound by Heat.

THE 'singing tube' has been the subject of a number of short sketches by me in American scientific journals. There is one form of it, however, that was exhibited at the Cavendish Laboratory in February last that has never been published, and a brief description of the tube in general and of this special form may be of interest to the readers of Nyruke.

The singing tube came to my notice quite by accident while blowing a mercury vapour trap for

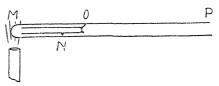


Fig. 1.

high vacuum work. Two reasons may be assigned as to why it was not discovered long before by research workers doing their own glass-blowing. They are: (a) the trap was blown of Pyrex glass (Monax would have answered quite as well), which permitted of more intense heating than soda glass, and (b) the sequence of operations in blowing happened to be such that it revealed this particular phenomenon. It was soon found that the tube could be given the more compact form shown in Fig. 1, drawn approximately to scale. The inner tube (a test tube) is held in the position shown by three legs fused to the outer wall, and to secure it against mechanical breakage three small supporting ribs (only one is shown) are equally spaced at N. Roughly, the area of the open end of the inner tube should be equal to the annular area between it and the outer tube. The outer tube is closed at M. When the tube is cool, place the tip M in a Bunsen burner flame (as shown in Fig. 1) and in a few moments the tube will emit, at its open end P, a tone of remarkable purity and loudness. The pitch depends

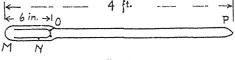


Fig. 2

on the length of the tube from O to M to P, this length corresponding approximately to one quarter of the wave-length of the tone emitted. Extensions attached at P lower the pitch. Two similar tubes simultaneously heated will sound beats. Many additional beautiful and striking experiments may be performed.

The special form of the tube alluded to above is made much longer, and in addition is closed it P, as shown in Fig. 2. On holding this tube  $\mathfrak{M}$  the hands and heating the tip M in a Bunsen flame the operator will feel the tube begin trembling, then violently, and yet no sound is heard. The whole

performance is uneamly and one is in danger of dropping the tube. The vibration of the air within will continue for some moments after the tube is removed from the flame. These vibrations may be made audible by placing the closed end P against a resonating body—one's head, a tin can, a light table, or against a wooden blackboard

The intensity of the tone emitted by these tubes is dependent upon the temperature difference that is established between the tip M and the rest of the tube. The pitch, as previously stated, is determined by the dimensions and is little affected by a change in temperature. It may be of interest to remark that when the body of the tube NOP, Fig. 1, is at room temperature, the tube will begin to sing when the tip is heated to about  $400^{\circ}$  C. When NOP is cooled to liquid air temperature, the tube will sing when the tip M is maintained at room temperature, which makes the temperature difference in this

which makes the temperature difference in this instance about 200° (' By extrapolation it was found that the temperature difference required it it were possible to cool NOP to absolute zero would be 80° Kelvin. The pitch of the tone emitted in each of the above examples is correspondingly lowered.

The tollowing physical explanation, in collaboration with Dr. Jakob Kunz, University of Illinois, is offered.

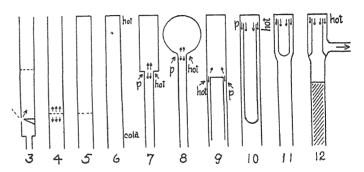
In the organ pipe, energy is supplied by a stream of an which encourages the vibrations in a one-sided way, so that the vibrating column receives an inpulse each time when the air moves upward towards the node in the niddle of the pipe, Fig. 3, and receives no involves in the converte

and receives no impulse in the opposite motion. It looks as if a pendulum were kept in oscillation by receiving at one end of its path an impulse always in the same direction. If we were to apply the momentum of the air-jet at the centre of the tube, vibrations of the column would be discouraged.

We can communicate momentum to a vertical open-air column by heating it. If we heat the air in the tube in Fig. 4 by a wire net placed in the lower half of the tube, we shall obtain a uniform current of air upwards. If the air is vibrating, then as it is moving inward its vibration is increased by the momentum of the upward stream of air, but not increased by moving downward. When we place the hot were net in the middle of the tube it will tend to increase the pressure of the gas when it is a minimum, i.e it will discourage oscillations. The same will happen when we place the net above the middle. In order to encourage oscillations we have to add momentum in a position and at a moment such that the pressure in the node increases more than it would do on account of the oscillations alone If we put the hot wire net at the lower end of the tube, i.e. in a loop, the effect will be very small, or zero. The transfer of lifat will depend upon the temperature of the air in contact with the wire net, being greatest when the temperature is lowest. But the temperature in the loop at the lower end does not vary; therefore, the transfer of heat in this position of the gauze does not give rise to oscillations. It tends only to raise the temperature of the gas uniformly. Heat must therefore be applied between a loop and a node.

If we cover the upper end of the tube, Fig. 5, with the hot net in the most favourable position, the sound ceases, and if we heat by means of a Bunsen burner the outside at the top, as in Fig. 6, we get no sound. This was considered by Rayleigh as possible ("Theory of Sound," vol. 2, p. 231). But if we change the cross-section of the tube, as in Fig. 7, and heat at p, then the tube will emit a sound. The pressure in the

upper half of the tube will increase, partly because the air is heated, partly because of the condensations of the air in the node on the top The air will expand, and now the expansion in the narrow neck is aided by the air being heated by the wall. Here the oscillations are encouraged because each time when the air is expanding by the oscillation the expansion is increased by the heat. In each cycle the vibrating particle receives one push in the right direction. It is this one-sidedness of the action which encourages the oscillations. Moreover, as the heat here has the tendency to increase the pressure near the node, the oscillations will start very readily. A slight modification of this experiment is the glassblower's bulb, Fig. 8, which emits a sound when heated around the neck, p. Instead of making the lower part of the tube narrower, as in Fig. 7, we might proceed as in Fig. 9, where the annular area takes the place of the narrow tube in Fig. 8. A modification of this tube is



the tube of Fig. 10, which will sound when heated at p and is much more sensitive. It is evident from the explanation that this tube will not sing when the lower end of the inner tube is open, because the one-sidedness of the action is destroyed. Slight modifications of Fig. 10 are the tubes represented in Figs 11 and 12. If we place a hot wire net inside the tubes of Figs 7, 8, 9, 10, 11, 12, where the hot flame was outside, the tubes will produce a sound. In all cases, in the organ pipe, in Rijke's experiment (Fig 4), and in the tubes in Figs. 7-12, the oscillations of a column of air are maintained by a one-sided addition of momentum at the right moment and in the right place.

These experiments belong to a large variety of phenomena in which a direct motion is transferred into a periodic motion, or, electrically speaking, where direct current is transformed into alternating current.

Chas. T. Knipp.

Cavendish Laboratory, Cambridge, July 12.

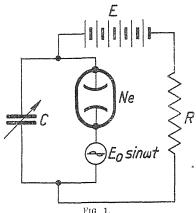
#### Frequency Demultiplication.

It is a well-known fact that when a sinusoidal E.M.F (of the form  $E_0 \sin \omega t$ ) is available, it is a relatively simple matter to design an electrical system such that alternating currents or potential differences will occur in the system, having a frequency which is a whole multiple of the applied E.M.F., e.g.  $2\omega$ ,  $3\omega$ , etc. For example, when the E.M.F.  $E_0 \sin \omega t$  is applied to a diode-rectifier, the current in the anode circuit will include a component of double frequency, i.e.  $2\omega$ . This is therefore one method of frequency multiplication. Several other methods could easily be mentioned.

Now we found it is also possible to design an electrical system such that when the above-mentioned

E.M.F.,  $E_0 \operatorname{sm} \omega t$ , is applied to it, currents and potential differences occur in the system the frequencies of which are whole submultiples of the frequency of the applied E M F.,  $eg=\omega/2,\;\omega/3,\;\omega/4$  up to  $\bar{\omega}/40$ .

To this end one can make use of the remarkable synchronising properties of relaxation-oscillations,



i e. oscillations the time period of which is determined by the approximate expression  $T = \pi/2 CR$ , a relaxation time (Balth, van der Pol, "On Relaxation Oscillations," Phil. Mag., p. 978, 1926; also Zeutschr. f. hochfreq. Technik, 29, 114; 1927).

Let Ne in Fig. 1 represent a neon glow lamp.

R a resistance of the order of a few megohins, C a

variable condenser of approximately maximum 3500 cm. capacity and E a battery of say 200 volts. In the absence of the E.M.F.  $E_0 \sin \omega t$ , this system will oscillate with a time period T = a C R where a is a number of the order unity. With the E.M.F.  $E_0 \sin \omega t$  present, where  $E_0$  may be of the order of 10 volts (considerably lower voltages also give the same result) it is found that the system is only capable of oscillating with discrete frequencies, these being determined by whole submultiples of the applied frequency. For example, with  $E_0 = 0$ , give Ua small value such that the natural relaxation frequency of the system is 1000 periods per second. Next apply the alternating voltage  $E_0 \sin \omega t$ , where  $\omega$  may be made  $2 \pi \times 1000 \text{ sec.}^{-1}$ , then

the system will go on oscillating with a frequency 1000 sec.-1. When now the applied  $E_0 \sin \omega t$  is left as before but C is gradually mcreased to a much greater value, it will be found that the system continues to oscillate with a frequency 1000 sec. 1. If C is next increased still further, the frequency of the oscillations in the system (as detected, for example, with a telephone coupled loosely in some way to the system) suddenly drops to 1000/2 sec.-1, to maintain this value over a certain range of the capacity value. If C is increased still more, the frequency suddenly jumps to 1000/3 sec.-1, and so on

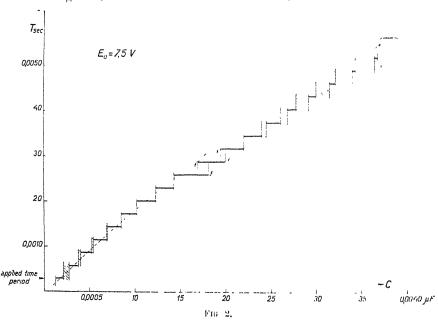
up to 1000/40 sec.<sup>-1</sup> In some recent experiments it was found possible to obtain a frequency demultiplication up to the ratio 1 1/200. Often an irregular noise is heard in the telephone receivers before the frequency jumps to the next lower value. However, this is a subsidiary phenomenon, the main effect being the regular frequency demultiplication. It may be noted that while the production of harmonies, as with frequency multiplication, turnishes us with tones determining the musical major scale, the phenomenon of frequency-division renders the musical minor scale audible. In fact, with a properly chosen 'fundamental' ω, the turning of the condenser in the region of the third to the sixth subharmonic strongly reminds one of the tunes of a bagpipe

In conclusion, we give in Fig. 2 the measured time periods (which are thus found to be a series of discrete subharmones) as a function of the setting of the condenser C. The dotted line in the figure gives the frequency with which the system oscillates in the absence of the applied alternating E.M.F. The shaded parts correspond to those settings of the condenser where an irregular noise is heard. In the actual experiment the resistance R was, for ease of adjustment, replaced by a diode. The experiment, however, succeeds just as well with an ohmic resistance R. Obviously the same experiment succeeds with all systems capable of producing relaxation-oscillations such as described in the papers quoted

Balth, van der Pol.

J. VAN DER MARK.

Natuurkundig Laboratorium der N. V. Philips' Gloeilampenfabrieken, Eindhoven, Aug 5.



# Movement in Fluid Dielectrics under Stress.

It has been suggested to me that I should describe briefly, for the benefit of readers of NATURE who may be interested, some experiments which I showed at the High Tension Conference in Paris a few weeks

In January last, as the result of a suggestion by Mr. G. L. Addenbrooke, who had previously investigated the phenomenon, I was able to demonstrate at the annual exhibition of the Physical Society, and

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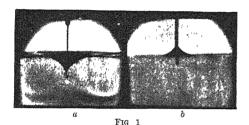
again at the Royal Institution, the rise of an oil surface under a charged sphere and the depression under a charged point. As the result of a series of further experiments, it is clear that these first two effects represent two distinct classes of phenomena, namely:

(1) The attraction of a high dielectric constant medium through a low dielectric constant medium into the strongest part of the field, and of course the repulsion of a low dielectric constant medium through one of high dielectric constant from the strong to the weak field, and

(2) the movement of a fluid dielectric under the influence of a stream of ionised air repelled from an

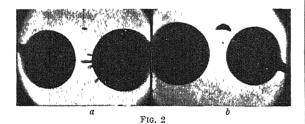
electrode

Fig. 1,  $\alpha$ , shows the cratering of an oil surface under an upper needle-point at about twenty thousand volts



alternating. This is effect (2). Air bubbles enter the oil at the point of the crater, but except at quite low voltages they circulate with the mass of oil *towards* the point.

When a thin rod is employed as upper electrode with its end immersed in the oil, the application of the voltage raises the meniscus as is expected from consideration (1) above and shown in Fig. 1, b. When a certain value of the voltage is attained, however, the oil is thrown down to its 'no voltage' level accompanied by violent circulation of the oil along the surface away from the electrode. By using in turn a number of electrodes of different diameter and comparing the voltage at which the conditions changed from a steady holding of the oil to the circulation, the calculated stress in the air was found to be the same as previously published values for critical stress in air around cylindrical wires.



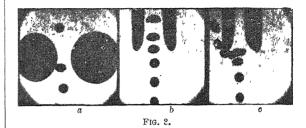
The electric wind effect is further shown by the repulsion of oil along the surface of a sheet of oiled paper standing on a flat electrode around an upper electrode in contact with the paper

Several effects arising out of consideration (1) above are shown in the remaining figures

Fig. 2, a, shows the attraction of castor oil (d c = 4 5) globules in a bath of transformer oil (d c.=21) into the strong field between two spherical electrodes, with 25 k v. difference of potential alternating, where they line up. Fig. 2, b, shows the repulsion of transformer oil globules in a bath of castor oil away from the strong field.

In Fig. 3,  $\alpha$ , bubbles of air rising through oil between charged spheres are elongated and repelled from the field, while Figs 3, b, and 3, c, show the same effects between plates. In the last figure the effect was so strong as to compel the stream of bubbles to avoid the gap entirely

The study of these movements is very much assisted by kinematograph projection, and besides



having a close bearing on the operation of cables, transformers, and other plant employing fluid dielectrics, it seems to me that they form a useful means of illustrating the principles involved

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W. T. Henley's Telegraph Works Co., Ltd., Gravesend, Kent

#### Climatic Changes: Their Causes and Influences.

In Nature of Aug 13 is published a review by Prof. J. W. Gregory of Dr. C E. P. Brooks's recent book, "Climate through the Ages." Referring to the remarkable evidence of a medieval deterioration of climate in Greenland, collected by the Danish expedition to Herjolfsnes, Prof. Gregory suggests that the alleged absence of ice before the thirteenth century was contradicted by the Sagas and had not been supported by any records of contemporary change of climate in Great Britain.

It is true that Sir Richard Gregory, in his presidential address to the Geographical Association in 1924, summarised a large mass of literary references dealing with British climate in historical times and failed to find any indications of such changes Nevertheless, Dr Brooks since that date has collected together a considerable body of evidence pointing to a medieval maximum of rainfall in Britain, Europe, and parts of Asia—This evidence is given in Chapters xviii, and xix of "Climate through the Ages."

A paper on "Early Water-mills in Relation to Changes in the Rainfall of East Kent," read before the Royal Meteorological Society on May 18 of this year, gives documentary records indicating that a period of heavy rainfall was drawing to a close in the latter part of the thirteenth century. The inconstant streams, or nailbournes, of Kent had been studied fairly completely by Mr. W. Whitaker (Momoir of Geol. Survey, 1908), who found that their flow depended only on the saturation level of the district. Unfortunately, Mr. Whitaker did not extend his search back beyond the fifteenth century, consequently he did not discover the extraordinary difference between the present character of these streams and that revealed by the entries in "Domesday Book" of watermills situated high up their valleys.

It would be absurd to accuse Prof. Gregory of adopting the forensic trick of passing over in silence unwelcome evidence. Probably he considers that the facts have been misinterpreted. It is not, perhaps, unreasonable to ask for his alternative explanation of these records. Quotations of the alleged critical

passages in the Sagas would also be welcomed by readers unfamiliar with this literature.

Georgie M. Meyer.

Victoria Terrace, South, Low Fell, Gateshead, Aug. 18.

I DID not refer to the two chapters mentioned as I had discussed that evidence twice previously (Geog. Jour., vol 43, 1914) and in a later paper in the Edinburgh Review. I read the two chapters with interest as they show the indefiniteness of the evidence carefully collected by Dr. Brooks, except as regards the local minor variations which are inevitable. Its inconsistency as indications of any world-wide or even widespread considerable climatic variation is shown by Mr. Meyer's case. He claims from the east Kent waternills that "a period of heavy rainfall was drawing to a close in the latter part of the thirteenth century." Dr. Brooks's table 22 (p. 345) gives a census of floods and droughts in Britain;

the maximum of floods, No. 9, was in 1051-1100, and instead of droughts in 1251-1300 being at a minimum, they were at a maximum. The figures for the seven half-centuries are as follows:

			nms an Floods	d Droughts
1001-1050			2	3
1051-1100			9	1
1101-1150			5	10
1151-1200			1	3
1201 - 1250	•		8	7
1251-1300			8	13
1301-1350		•	3	7

The thirteenth century had more recorded droughts, according to this table, than any century before the seventeenth. Mr. Meyer refers also to Asia; and according to Dr. Brooks's table 27 (p. 364) for China, the thirteenth century was less rainy than either its predecessor or suc-

cessor. The figures for rainness are: tenth century, 36; eleventh, 37; twelfth, 49; thirteenth, 36; four-teenth, 49.

I have not the Sagas to refer to, as I write from the country, but my remark regarding them was made after consultation with an authority on East Greenland who knows the Sagas well. I warmly welcome Dr. Brooks's advocacy of the dependence of glaciations and climatic variations on geographical changes and in accordance with that argument would expect that so great a change as the absence of ice from the Arctic Ocean and from the East Greenland Sea would have been attended by more marked changes in British weather than those recorded by Dr. Brooks.

J. W. Gregory.

# Fluctuations in Affective Reactions to the Odour of Caraway Oil.

During a period of two months I have arranged thirty odours in order of preference on forty occasions. Unfortunately, circumstances did not permit of this serial arrangement at regular intervals. As was to be expected, the position in the series of the very pleasant and the very unpleasant odours showed considerably less (if any) variation than the position of the relatively neutral odours. Fluctuations in the affective reactions to caraway oil claimed attention, as the median place in the series was found to be

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higher (fourteenth) after lunch than that before (sixteenth). A similar post-praidial preference, though not so pronounced, was noticed in the ease of dill oil, which likewise contains carvone. Musk appeared to be experienced as relatively less pleasant after the meal. In the ease of camphor, rosemary oil, menthol, sassatras oil, feinel oil, and a few other observed.

A further phenomenon of some interest proved to be that a rise in the preference for caraway oil appeared to be correlated with a fall in the preference for the odour of camphor and rosemaly oil. A similar negative correlation of affective reactions, though relatively low, appeared in the case of dill oil and camphor. The accompanying diagram (Fig. 1), showing fluctuations in the median position of caraway oil and camphor on different dates, also indicates an interesting possibility of a periodic fluctuation in maffective reactions to odours. Such fluctuations have been proviously observed by me in the case of a few female subjects during menstruation, while a certain

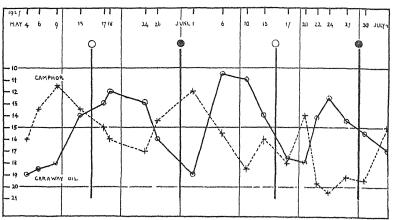


Fig. 1.- Fluctuations in relative preference to odour of caraway oil and of camphor. Numbers on axis of ordinates refer to median podtion in a series of thirty odoms arranged in order of preference. White circles indicate date of full moon, black circles date of new moon.

correlation between menstruction and lumar periods has been demonstrated by Arrhenius (Skand. Arch. f. Physiol., 1898), as quoted by H. M. Fox (Proc. Roy. Soc., B. vol. 95, 1923). A ten-day periodicity in Obelia has been recorded by R. Elmhirst (Nature, Sept. 5, 1925).

In view of abundant information on the anatomical and physiological relations between the organs of smell and sex in man, facilities are required for further experimentation on a large scale, taking into consideration the various factors involved, physical, chemical, physiological, and psychological. It may be mentioned that, notwithstanding common belief, fluctuations in the degree of pleasantness or otherwise of odours, are by no means always concomitant with affective roactions due to recall of associations.

J. H. KENNETH.

The Homestead, Clynder, Dumbartenshire.

# Hot-wire Microphone and Audio-resonant Selection.

UNDER the heading "News and Views" on page 235 of NATURE for Aug. 13, reference is made to my recent paper to the Radio Society of Great Britam on the "Hot-wire Microphone and Audio-resonant Selection." The writer of the note is, I fear, too optimistic with regard to the possible applications of my paper. The invention relates to the selection and

recording of Morse telegraphic signals I think that his conclusion that there is no reason why more frequencies could not be selected in the wave bands at present employed for broadcasting misses the

Broadcasting employs a band of radio-frequency wave-lengths, and the whole range of audio-frequencies between about 26 oscillations per second to about 8000 have to be received simultaneously. Audioresonant selection, on the other hand, can be carried out on very sharply tuned radio-frequencies, and its whole object is to pick out one musical note only, and to reject all other audio-frequencies except that to which the resonator is attuned.

If this principle were applied to broadcast reception, one note only would be picked out whenever it occurred, and all the rest of the music would be

rejected

I notice also that I am credited with a statement that Sir Wm Pieece described the "Hot-wire Microphone or Thermo Telephone" to the Royal Society in 1880. In point of fact, these are two separate mstruments, and, as I pointed out in my lecture. Sir Wm Preece described the thermo-telephone in 1880, but the hot-wire microphone (or red hot wire telephone transmitter, as it was then called) was described by Prof. Geo Forbes to the Royal Society in 1887 G. G. BLAKE

Onslow Road, Richmond, Surrey, Aug 16.

#### A Vibrating Soap Jelly.

Some years ago, H. N. Holmes showed that a silicic acid jelly could be prepared which gives a musical tone on tapping. It is perhaps worth putting on record that the same phonomenon can be exhibited by a soap jelly, as Mr. P. van Campen happened to discover in this laboratory A bottle had been nearly filled with ordinary soft soap and set aside. a few months it turned out that a clear jelly had been formed. On tapping the bottle gently, it gave a very low but distinctly audible tone. It is particularly noteworthy that, whereas the silicic acid jelly is rather stiff and brittle, the soap jelly is very soft, and yields to a slight pressure of the finger.

The pitch of the tone was very low. It was a little higher after the soap had been kept at room temperature for about three months. After cooling in the ice-box, the pitch was raised again a little, as might be expected. When warmed above 25°, the jelly began to melt, but set again when cooled

and showed the phenomenon anew.

It would appear that the soap crystallises to a network of crystal fibres possessing sufficient rigidity to allow sound vibrations At a low temperature the crystals increase in number and in size at the cost of the solution contained between the network, whilst they dissolve again on warming.

I am informed that the same phenomenon has sometimes been observed in a soap factory in Holland. E. H. Buchner.

Chemical Laboratory, The University, Amsterdam.

#### Electric Charges on Omnibuses.

When light steam waggons fitted with rubber tyres were first run upon the roads, it was found desirable to provide an earthing device consisting of a short piece of chain which dangled from the vehicle to the ground in order to dissipate the electric charge which accumulated on the vehicle due to the escape of the

Under favourable weather conditions and after descending a long incline with the brakes on, the ordinary motor omnibus also becomes charged to such an extent that upon approaching the bus, just before it has stopped, a spark about 1 cm. long bridges the gap between the hand-rail and the passenger's finger.

The spark is quite attenuated, and the only sensation is a slight pin-prick, though this might be unpleasant to people who are specially sensitive to electric shocks, and it would seem that an earthing device similar to that used on steam waggons should

be provided.

That such a shock is present is known to some of the conductors, and it is usually attributed to some slight leakage from the magneto, though this is unlikely in view of the length and comparative weakness of the spark.

I have frequently noticed this effect in boarding a No. 111 bus about half-way down Crouch Hill, N.S.

L. Bellingham.

71 Hornsey Rise, London, N 19.

#### Food-Value of Pasture Grass.

The editorial article in Nature of July 16 directs attention to the important results secured at the Cambridge School of Agriculture on the value of young pasture grass as a concentrated food for stock. In the Prairie Provinces of Canada, annual and winter annual cereals are used very widely for both hay and pasture. It may be of interest, therefore, to refer to some analyses of such material carried out at the University of Alberta.

The dry matter of young wheat plants, collected at various times in the autumns of 1921 and 1923, contained from 21 to 34 per cent of crude protein, of which about 90 per cent. was in a fluid condition in the cells. Of the total dry substance in the plants, from two-thirds to three-fourths was contained in the tissue fluids. The detailed analyses have been published in another connexion (Alta. Coll. of Agr. Research Bull. No. 1; 1924, and Jour. Agric. Sci.,

16, 522-538; 1926).
While no teeding trials were made, the analyses seem to leave no doubt that this material should rank as a high-class concentrate. R. NEWTON.

Edmonton, Alberta, Canada, Aug. 12.

#### Corrosion of Copper Pipes.

THE presence of a metal tends to inhibit the corrosion of a more electro-positive metal. On the other hand, when a metal is coated with a material to which it is electro-negative, it is well known that intense local corrosion is apt to ensue if defects arise in the coating.

Copper utensils are effectively protected by a coating of tin, the potential between copper and tin being about +0 4 volt. Tin, however, is not a suitable lining for copper water pipes. The explanation of this anomaly is that in a pipe the tin lining does not keep bright. On tarnishing it becomes more electro-positive and is ultimately electro-positive to copper. In this condition it is pernicious.

The potential between copper and the tarnished tin lining of a pipe (in water) was found to be -0.1volt. this pipe failed by local corrosion.

A. F. DUFTON. F. L. BRADY.

Building Research Station, Garston, Herts, Aug. 15.

# The Outstanding Problems of Relativity. By Prof E T WHITTAKER, FR.S

IT was in January 1914 that Einstein (Zeits f. Math in Phys., 63, p. 215., 1914) made his great departure from the Newtonian doctrine of gravitation by abandoning the idea that the gravitational potential is scalar. The thirteen eventful years which have passed since then have seen the rapid development of the new theory, which is called General Relativity, and the confirmation by astronomers and astrophysicists of its predictions regarding the bending of light-rays by the sun and the displacement of spectral lines. At the same time a number of new problems have arisen in connexion with it, and perhaps the time has now come to review the whole situation and to indicate where there is need for further investigation.

Prof. G. F FitzGerald of Dublin long held an opinion which he expressed in 1894 in the words "Gravity is probably due to a change of structure of the ether, produced by the presence of matter" (FitzGerald's "Scientific Writings," Perhaps this is the best description of Einstein's theory that can be given in a single sentence in the language of the older physics: at any rate it indicates the three salient principles, first, that gravity is not a force acting at a distance, but an effect due to the modification of space (or, as FitzGerald would say, of the ether) in the immediate neighbourhood of the body acted on secondly, that this modification is propagated from point to point of space, being ultimately connected in a definite way with the presence of material bodies, and thirdly, that the modification is not necessarily of a scalar character. The mention of the ether would be criticised by many people to-day as something out-of-date and explicable only by the circumstance that FitzGerald was writing thirtythree years ago; but even this criticism will not be universal; for Wiechert and his followers have actually combined the old ether theory with ideas resembling Einstein's by the hypothesis that gravitational potential is an expression of what we may call the specific inductive capacity and permeability of the ether, these qualities being affected by the presence of gravitating bodies. Assuming that matter is electrical in its nature, it is inferred that matter will be attracted to places of greater dielectric constant. It seems possible that something of this sort was what FitzGerald had in mind.

Let us now consider some of the consequences of Einstein's theory. One of the first of them is that when a planet moves round a central attracting body in a nearly circular orbit, the perihelion of the orbit advances by (approximately)  $6\pi v^2/c^2$  in each revolution, where v is the planet's velocity and c is the velocity of light. This gives for the motion of the perihelion of Mercury almost exactly the amount (42" per century) which is found from observation. Another consequence is that lightrays which pass near a massive body are deflected, the bending at the sun's limb being  $1^{"\cdot75}$ . This

<sup>1</sup> From the presidential address to Section A (Mathematical and Physical Sciences) of the British Association delivered at Leeds on Sept. 5.

was confirmed observationally by the British expeditions to the eclipse of May 1919, and still more decisively by the Lick Observatory expedition to the Australian eclipse of September 1922 · the Lick observers found for the shift 1".72 + 0".11, which differs from Einstein's predicted value by much less than its estimated probable error Yet another result of general relativity is that, by the Principle of Equivalence, light which reaches us from a place of different gravitational potential (such as the sun) must exhibit a kind of Doppler effect This 'gravitational shift of the solar spectral lines' is now generally admitted to be confirmed by comparisons of wave-lengths at the centre of the sun's disc with wave-lengths from the arc in vacuo; and in 1925 the effect was observed, on a much larger scale, by W. S. Adams in the spectrum of the companion of Sirius

Besides the effects which have been verified observationally, there are many consequences of Einstein's theory which are of interest as opening up new fields or presenting new inter-relations of phenomena in astronomy and physics For example, there is a contribution to the precession of the equinoxes which, unlike ordinary precession, does not depend on the oblateness of the earth. Agam, the bending of the rays of light near a gravitating body, which has been observed in the case of the sun and the companion of Sirius, may, theoretically at any rate, be so pronounced that the ray is permanently captured by the attracting body, and describes for ever a track round and round it, which approaches spirally and asymptotically to a circle the centre of which is at the centre of gravitation. Yet another deduction is that an electrified body, or a single electron, which is at rest in a varying gravitational field, must emit radiation. Indeed, now that a definite connexion has been set up between electricity and gravitation, the whole of electromagnetic theory must be rewritten.

As a further illustration of the (as yet) unexplored possibilities of the new physics, let us consider the well-known equations for the potential of Newtonian gravitation, namely, Laplace's equation in space where there is no matter, and Poisson's equation in space where matter of density  $\rho$  is present. In general relativity, when the field is statical, these are replaced by an equation which reduces to Laplace's equation in one extreme case (when no matter or energy is present at the point) and to Poisson's equation in another extreme case (when the energy is entirely in the form of ordinary matter), but it offers an infinite variety of possibilities intermediate between the two, in which energy is present but not in the form of ordinary matter. It is possible that this equation, which evidently suggests an approach to the new wavemechanics, may play as important a part in the microphysics and astrophysics of the future as the equations of Laplace and Poisson have played in the ordinary physics of the past.

The fundamental researches of Einstein and Hilbert, with the discovery of the field equations of gravitation, were published in 1915. At that time German scientific journals did not reach Great Britain regularly, and British physicists and mathematicians were mostly occupied in one way or another with duties arising out of the Great War, so that comparatively little notice was taken of the new theory on this side of the North Sea during the first year or two of its existence, and indeed it was not until the end of the War that most of us had any opportunity of studying it In Germany, however, it was quickly realised that general relativity was one of the most profound and far-reaching contributions that had ever been made to science Its successful prediction of new phenomena of a most unexpected kind was an event of the first importance, but still more significant was its complete subversion of the foundations of physics and reconstruction of the whole subject on a new basis. From time immemorial the physicist and the pure mathematician had worked on a certain agreement as to the shares which they were respectively to take in the study of Nature. The mathematician was to come first and analyse the properties of space and time, building up the primary science of geometry, then, when the stage had thus been prepared, the physicist was to come along with the dramatis personæ—material bodies, magnets, electric charges, light, and so forth-and the play was to begin But in Einstein's revolutionary conception, the characters created the stage as they walked about on it: geometry was no longer antecedent to physics, but indissolubly fused with it into a single discipline. The properties of space, in general relativity, depend on the material bodies that are present; Euclidean geometry is deposed from its old position of priority, and from acceptance as a valid representation of space; indeed its whole spirit is declared to be alien to that of modern physics, for it attempts to set up relations between points which are at a finite distance apart, and thus is essentially an actionat-a-distance theory; and in the new world no direct relations exist at all except between elements that are contiguous to each other.

The scheme of general relativity, as put forward by Einstein in 1915, met with some criticism as regards the unsatisfactory position occupied in it by electrical phenomena. While gravitation was completely fused with metric, so that the notion of a mechanical force on ponderable bodies due to gravitation attraction was completely abolished, the notion of a mechanical force acting on electrified or magnetised bodies placed in an electric or magnetic field still persisted as in the old physics This seemed to be an imperfection, and it was felt that sooner or later everything, including electromagnetism, would be re-interpreted and represented m some way as consequences of the pure geometry of space and time In 1918, Weyl proposed to effect this by rebuilding geometry once more on a new foundation He devised a geometry more general than the Riemannian geometry which had been adopted by Einstein, instead of being specified, like the Riemannian geometry, by a single quadratic differential form, it is specified by a quadratic differential form and a linear differential form together. Thus he succeeded in exhibiting both gravitation and electricity as effects of the metric of the world

The enlargement of geometrical ideas thus achieved was soon followed by still wider extensions of the same character, due to Eddington, Schouten, Wirtinger, and others. From the point of view of the geometer, they constituted striking and valuable advances in his subject, and they seemed to offer an attractive prospect to the physicist of combining the whole of our knowledge of the material universe into a single unified theory The working out of the various possible alternative schemes for identifying these more general geometries with physics has been the chief occupation of relativists during the last nine years. Many ingenious proposals and adaptations have been published, and more than one author has triumphantly announced that at last the problem has been solved But I do not think that any of the theories can be regarded as satisfactory, and within the last year or two a note of doubt has been perceptible, Were we after all on the right track  $^{2}$  At last Einstein himself (Math Ann, 97, p. 99; 1926) has made up his mind and renounced the whole movement. The present position, then, is that the years 1918-1926 have been spent chiefly in researches which, while they have contributed greatly to the progress of geometry, have been on altogether wrong lines so far as physics is concerned; and we have now to go back to the pre-1918 position and make a fresh start, with the definite conviction that the geometry of space-time is Riemannian.

Granting, then, this fundamental understanding, we have now to inquire into the axiomatics of the theory. This part of the subject has received less attention in Great Britain than elsewhere, perhaps because of the more or less accidental circumstance that the most prominent and distinguished exponents of relativity in England happened to be men whose work lay in the field of physics and astronomy rather than in mathematics, and who were not specially interested in questions of logic and rigour. It is, however, evidently of the highest importance that we should know exactly what assumptions must be made in order to deduce our equations, especially since the subject is still in a rather fluid condition.

What we want to do, then, is to set forth the axiomatics of general relativity in the same form as we have been accustomed to give to the axiomatics of any other kind of geometry—that is, to enunciate the primitive or undefined concepts, then the definitions, the axioms, and the existence-theorems, and lastly the deductions. In the course of the work we must prove that the axioms are compatible with each other, and that no one of them is superfluous.

The usual way of introducing relativity is to talk about measuring-rods and clocks. This is, I think,

a very natural and proper way of introducing the doctrine known as 'special relativity,' which grew out of FitzGerald's hypothesis of the contraction of moving bodies, and was first clearly stated by Poincaré in 1904, and further developed by Einstein in 1905. But general relativity, which came ten years later, is a very different theory. In general relativity there are no such things as rigid bodies-that is, bodies for which the mutual distance of every pair of particles remains unaltered when the body moves in the gravitational field. That being so, it seems desirable to avoid everything akin to a rigid body—such, for example, as measuring-rods or clocks-when we are laying down the axioms of the subject. The axioms should obviously deal only with the simplest constituents of the universe. Now if one of my clocks or watches goes wrong, I do not venture to try to mend it myself, but take it to a professional clockmaker, and even he is not always wholly successful, which seems to me to indicate that a clock is not one of the simplest constituents of the universe. Some of the expounders of relativity have recognised the existence of this difficulty, and have tried to turn it by giving up the ordinary material clock with its elaborate mechanism, and putting forward in its place what they call an atomic clock; by which they mean a single atom in a gas, emitting light of definite frequency. Unfortunately, the atom is apparently quite as complicated in its working as a material clock, perhaps more so, and is less understood; and the statement that the frequency is the same under all conditions, whatever is happening to the atom, is (whether true or not) a highly complex assumption which could scarcely be used in an axiomatic treatment of the subject until it has been dissected into a considerable number of elementary axioms, some of them perhaps of a disputable character.

It seems to me that we should abandon measuringrods and accurate clocks altogether, and begin with something more primitive. Let us then take any system of reference for events—a network of points to each of which three numbers are assignedwhich can serve as spatial co-ordinates, and a number indicating the succession of events at each point to serve as a temporal co-ordinate. Let us now refer to this co-ordinate system the paths which are traced by infinitesimal particles moving freely in the gravitational field. Then it is one of the fundamental assumptions of the theory that these paths are the geodesics belonging to a certain quadratic differential form The truth or falsity of this assumption may, in theory at any rate, be tested by observation, since if the paths are geodesics they must satisfy certain purely geometrical conditions, and whether they do or not is a question to be settled by experience

Granting for the present that the paths do satisfy these conditions, let us inquire if a knowledge of the paths or geodesics is sufficient to enable us to determine the quadratic form. The answer to this is in the negative, as may easily be seen if we consider for a moment the non-Euclidean geometry defined by a Cayley-Klein metric in

three-dimensional space. In the Cayley-Klein geometry the geodesics are the straight lines of the space; but a knowledge of this fact is not sufficient to determine the metric, since the Absolute may be any arbitrary quadric surface

In order to determine the quadratic form in general relativity we must, then, be furnished with some information besides the knowledge of the paths of material particles. It is sufficient, as Levi-Cività has remarked, that we should be given the null geodesics, i.e. the geodesics along which the quadratic form vanishes. In the Cayley-Klein geometry these are the tangents to the Absolute, in general relativity they are tracks of rays of light.

So from our knowledge of the paths of material particles and the tracks of rays of light we can construct the particular quadratic form, and then we are ready for the next great axiom, namely, Einstein's Principle of Covariance The point I wish specially to make is that in the above treatment there has been no mention either of length or of time: neither measuring-rod nor clock has been introduced in any way. We have left open the question whether the quadratic form does or does not represent anything which can be given directly by measuring-rods and clocks For my own part I incline to think that the notions of length of material bodies, and time of clocks, are really rather complex notions which do not normally occur in the early chapters of axiomatic physics. The results of the ether-drift experiments of D. C. Miller at Mount Wilson in 1925, if confirmed, would seem to indicate that the geometry which is based on rigid measuring-rods is actually different from the geometry which is based on geodesics and light-rays.

The actual laws of Nature are most naturally derived, it seems to me, from the Minimum Principle enunciated in 1915 by Hilbert. This principle is the grand culmination of the movement begun 2000 years ago by Hero of Alexandria with his discovery that reflected light meets the mirror at a point such that the total path between the source of light and the eye is the shortest possible. In the seventeenth century, Hero's theorem was generalised by Fermat into his "Principle of Least Time" that "Nature always acts by the shortest course," which suffices for the solution of all problems in geometrical optics. A hundred years later, this was further extended by Maupertuis, Euler, and Lagrange, into a general principle of 'Least Action' of dynamical systems, and in 1834, Hamilton formulated his famous Principle which was capable of reducing all the known laws of Nature—gravitational, dynamical, and electrical —to a representation as minimum-problems

Hilbert's minimum principle in general relativity is a direct application of Hamilton's principle, in which the contribution made by gravitation is the integral of the Riemann scalar curvature. Thus gravitation acts so as to make the total amount of the curvature of space-time a minimum: or, as we may say, gravitation simply represents a continual effort of the universe to straighten itself out. This is general relativity in a single sentence.

I have already explained that the curvature of space-time at any point at any instant depends on the physical events that are taking place there. in statical systems, where we can consider space of three dimensions separately from time, the mean curvature (ie. the sum of the three principal curvatures) of the space at any point is proportional to the energy-density at the point. Since, then, the curvature of space is wholly governed by physical phenomena, the suggestion presents itself that the metric of space-time may be determined wholly by the masses and energy present in the universe, so that space-time cannot exist at all except in so far as it is due to the existence of matter This doctrine, which is substantially due to Mach, was adopted in 1917 by Einstein, and has led to some interesting developments. The point of issue may be illustrated by the following concrete problem. If all matter were annihilated except one particle which is to be used as a testbody, would this particle have mertia or not? The view of Mach and Einstein is that it would not; and in support of this view it may be urged that, according to the deductions of general relativity, the inertia of a body is increased when it is in the neighbourhood of other large masses; it seems needless, therefore, to postulate other sources of inertia, and simplest to suppose that all inertia is due to the presence of other masses confront this hypothesis with the facts of observation, however, it seems clear that the masses we know to exist—the solar systems, stars, and nebulæ—are insufficient to confer on terrestrial bodies the inertia which they actually possess; and, therefore, if Mach's principle were adopted, it would be necessary to postulate the existence of enormous quantities of matter in the universe which have not been detected by astronomical observation, and are called into being simply in order to account for mertia in other bodies. is, after all, no better than regarding some part of inertia as intrinsic.

Under the influence of Mach's doctrine, Einstein made an important modification of the fieldequations of gravitation. He now objected to his original equations of 1915 on the ground that they possessed a solution even when the universe was supposed void of matter, and he added a term the 'cosmological term' as it is called—with the idea of making such a solution impossible. After a time it was found that the new term did not do what it had been intended to do, for the modified field-equations still possessed a solution the celebrated 'De Sitter world'—even when no matter was present; but the 'De Sitter world' was found to be so excellent an addition to the theory that it was adopted permanently, and with it of course the 'cosmological term' in the fieldequations; so that this term has been retained for exactly the opposite reason to that for which it was originally introduced.

The 'De Sitter world' is simply the universe as it would be if all minor irregularities were smoothed out: just as when we say that the earth is a spheroid, we mean that the earth would be a spheroid if all mountains were levelled and valleys filled up. In the case of the De Sitter universe, the levelling is a more formidable operation, since we have to smooth out the earth, the sun, and all the heavenly bodies, and reduce the world to a complete uniformity. But after all, only a very small fraction of the cosmos is occupied by material bodies; and it is interesting to inquire what spacetime as a whole is like when we simply ignore them.

The answer is, as we should expect, that it is a manifold of constant curvature. This means that it is isotropic (i.e the Riemann curvature is the same for all orientations at the same point), and is also homogeneous As a matter of fact, there is a well-known theorem that any manifold which is isotropic in this sense is necessarily also homogeneous, so that the two properties are connected manifold of constant curvature is a projective manifold, i e. ordinary projective geometry is valid in it when we regard geodesics as straight lines, and it is possible to move about in it any system of points, discrete or continuous, rigidly, ie so that the mutual distances are unaltered

We are thus brought to the question of the dimensions of the universe  $\dot{}$  What is the length of the complete straight line, the circuit of all space ? The answer must be furnished by astrophysical observations, interpreted by a proposition which belongs to the theory of 'De Sitter's world,' namely, that the lines of the spectrum of a very distant star should be systematically displaced, the amount of displacement is proportional to the ratio of the distance of the star from the observer to the constant radius of curvature R of the universe. In attempting to obtain the value of R from this formula we meet with many difficulties: the effect is entangled with the ordinary Doppler effect due to the radial velocity of the star; it could in any case only be of appreciable magnitude with the most distant objects, and there is the most serious difference of opinion among astronomers as to what the distance of these objects really is. Within the last twelve months the distance of the spiral nebula M 33 Trianguli has been estimated by Dr Hubble, of the Mount Wilson Observatory, at 857,000 light-years, and by Dr. Perrine, the Director of the Cordoba Observatory, at only 30,000 light-years; and there is a similar uncertainty of many thousands per cent. in regard to all other very remote objects.

In these circumstances we hesitate to assign a definite length for the radius of curvature of the universe; but it is millions of light-years, though probably not greater than about a hundred millions. The curvature of space at any particular place due to the general curvature of the universe is therefore quite small compared to the curvature which may be imposed on it locally by the presence of energy. By a strong magnetic field we can produce a curvature with a radius of only 100 light-years, and of course in the presence of matter the curvature is far stronger still. So the universe is like the earth, on which the local curvature of hills and valleys is far greater than the general curvature of the terrestrial globe.

# Influence of Internal Secretions on Sex Characters.

AT the Edinburgh meeting of the British Medical Association, Dr F A. E. Crew opened an interesting discussion in the Section of Physiology and Bio-chemistry on the "Influence of Internal Secretions on Sex Characters." The importance of the organs of the endocrine system in regulating and controlling sex characteristics has been recognised for the past thirty years or so, but it is only recently that we have come to have a clear understanding of the rôle of the component members of this glandular system and the balanced action which exists between them.

Crew classified the sex dimorphic characters as (1) primary genotypic, (2) secondary genotypic (including the primary gonadic), and (3) secondary gonadic. There is no difficulty in demonstrating the dependence of the secondary gonadic characters on the physiological activity of the gonad. It is now established that the gonad influences the growth of the long bones, the development of the muscular and nervous systems, and plays an important part in general metabolism. The gonad also exerts a powerful influence over the structure and functions which form the secondary sexdimorphic characters

The function of the genads in regulating growth and development may be studied by the usual experimental procedure, namely, (1) removal of the genad, (2) implantation of the genad, and (3) administration of preparations of the gland

The effect and results of removal of the gonad will vary according to the development of the body and the physiological condition at the time that the operation is carried out. These conditions may be summarised as (1) pre-pubertal, and (2) post-pubertal. The first result of castration before the age of puberty is the hinderance to further development of the reproductive system. Castration on one side produced no effect, the retention of a single testis being sufficient to maintain normal function. In the human, castration at the same stage is known to prevent the growth of hair on the face, the development of the thorax, pelvis, and to preserve the voice of childhood. Further, metabolism is disturbed, the deposition of fat is marked, accumulating under the breasts and in gluteal regions.

The effect of castration on the development of the long bones has been well studied, and the evidence is now clear that the absence of the active gonad leads to an abnormal growth of bony tissues. Poucet in 1897 found that the bones and skeleton of the castrated rabbit were larger than those of the control. Geddes has also shown that the process of ossification is prolonged, and that the long bones are unduly long. These findings do not necessarily imply that the processes of nutrition and growth are opposed to reproduction. After castration, there is not only absence of the internal secretion from the gland, but there is further a loss of balance in the endocrine system during a period of rapid development of the body

structure.

Castration after onset of puberty is followed by disappearance of the beard and redistribution of the body fat and hair. It is clear that castration never induces any condition resembling the female type, the condition is infantile and not female. Extirpation of both ovaries in the human after puberty is followed by cessation of menstruation. Atrophy of the genitalia is also well marked. The operation may also lead to emotional disturbances, headache, fainting, and intestinal disturbances

Probably the most interesting results which have been obtained are those on gonad implantation. There is no difficulty in demonstrating that an animal which has been castrated at an early age will develop normally if a testis is successfully implanted It is also possible to restore the female characters by implanting ovarian tissue after ovariotomy. The degree of restoration possible will depend on (1) the age of the animal at the time of castration or ovariotomy, (2) the condition of the tissues at the time of implantation, and (3) the interval between the two operations. It will be seen that restoration is not possible if pathological changes have taken place in the tissues after removal of the gonad. Further, secondary sex characters can be re-established, as has been shown by Nussbaum. Castration of the male frog inhibits the development of the sexual pad on the first digit of each fore-limb, but after introduction of pieces of testis into the dorsal lymph sac, the swelling on the thumb and hypertrophy of the muscles of the fore-limb took place as in the normal animal.

It is possible to feminise a male by castration and subsequent implantation of ovarian tissue; the mammary glands are stimulated into activity while the male sex organs diminish in size. The converse is also possible, namely, to masculinise a female by ovariotomy and subsequent implantation of testes. These experiments certainly suggest that the sex hormones are specific.

Much attention has recently been devoted to implantation of testicular grafts from anthropoids into the human host. The success of these operations will depend not only on the technique of the operation but also on the ability of the host to provide the nutrition necessary for the continued life of the implant. The effect of the graft on the body will depend on the condition of the tissues at the time of operation. It is possible to supply and supplement the gonadic hormone and to re-establish the balance between the components of the endocrine system. It is not possible, however, by increase of sex hormone to re-establish a physiological condition if pathological changes have taken place

In Crew's study of about one hundred and fifty hermaphrodite pigs, he has found only testicular tissue present, though usually intra-abdominally. The sex characters, however, fell into a graded series from a normal male up to an almost female type of animal. A certain minimum threshold of secretion exists which is essential before

differentiation of the sex characters can occur A condition of ovo-testes is frequently found amongst pigs either on one or both sides ovary is always cephalic and on the left side. showing that differentiation must take place from right to left and from cephalic to caudal poles. If the ovary was able to initiate the development. the animal would tend to develop female characters during its early days, the degree of maleness appearing later in life depending upon the extent to which the secretion of the slower differentiating testes was able to counteract the ovarian secretion This would explain the tendency to maleness exhibited in the human by girls as they grow Macmillan's recent discovery of a chemical test for sex should prove useful in the solution of these problems.

Evidence that the ovarian extract as at present used is responsible for the slow ante-pubertal growth of the female sex-organs is not conclusive The supposed hypertrophy is sudden, occurring within forty-eight hours, and it only produces the changes associated with cestrus. Injection into the new-born rat is without effect, while injection into the animal three weeks old produces æstral changes. Further, ovarian extract does not produce the psychical changes normally associated with the cestrus cycle Parkes, from his investigations, concluded that the ovarian extract at present in use probably contains the responsible factor for the production of œstral changes, and that another substance is responsible for the pubertal and psychical changes.

Evidence was put forward by Glynn in the discussion for the supposed relationship of the suprarenal cortex to secondary sex characters. This evidence is summarised under the four headings

- (1) Embryological—Cortex of the suprarenal gland and the ovary and testis are derived from the same source
- (2) Physiological—Enlargement of the suprarenal glands during pregnancy
- (3) Pathological—In hermaphroditism there is bilateral enlargement of the suprarenals in the female
- (4) Clinical—Hypernephroma or tumour of the suprarenal associated with pseudo-hermaphroditism

In females suffering from adrenal hypernephroma, there is often atrophy of the mammary glands, ovary, and uterus, with cessation of menstruation, alteration in metabolism, mainly fat metabolism, and a general tendency to increase the male primary and secondary sexual characters at the expense of the female

Tumour formation in the adrenals leads to a profound disturbance of normal metabolic conditions, and it is possible that while the endocrine glands may exert no direct influence upon the secondary sex characters, yet they may have a pronounced indirect effect by bringing about abnormal conditions of metabolism Crew has demonstrated that cockerels, fed on thyroid from the time of hatching, developed female colour and type of feathering. Further, gonadectomy and gonad implantation do not lead to any apparent change in the metabolism of the animal, and, after operation, the endocrine glands appeared to be normal appears probable, then, that the secondary sex characters are under control of the gonad secretion, but with abnormal conditions of metabolism, a new threshold for the differentiation of the tissues is established.

# The British Association at Leeds.

THE general opinion on all hands seems to be that the meetings of the British Association in Leeds have been a great success; certainly from the point of view of the citizens of Leeds, they will be remembered as a fitting celebration of the arrival of summer After the most dismal August in the recorded meteorology of the area, the meetings have heralded a change to sunny weather and blue skies, with that bracing keenness in the air that prevents lassitude. Whilst the excursions have thus been made doubly enjoyable, the weather has also been appropriate for the strenuous follower of sectional activities.

Comparatively few seats were empty when the president's address was delivered in the Majestic Picture Theatre. This meeting was noteworthy for the announcement by the president of the Council's support of a movement to purchase Charles Darwin's home and estate at Downe, so that it may be retained in perpetuity for the nation. The enthusiastic applause of the vast audience showed their cordial sympathy with the proposal. Sir Oliver Lodge, who, in the absence of the retiring president, H.R.H. The Prince of Wales, was in the chair and introduced Sir Arthur Keith, alluded in felicitous terms, as also later did the president him-

self, to the generous anonymous gift of £100,000 to the appeal fund of the University of Leeds—a sum to be devoted to the erection of the new library. The announcement of this gift in the press on the same day as the maugural meeting naturally added to the general enthusiasm with which the proceedings were initiated, and gave added force to the vice-chancellor's hope, expressed in his opening remarks of welcome at the inaugural meeting, that on a future occasion the University may be then able to accommodate all the activities of the Association within its walls It has since been announced that the University owes this gift to Sir Edward Brotherton, a well-known chemical manufacturer with works at Leeds and Liverpool, to whom the University was already indebted for a gift of £20,000 for bacteriological research. Sir Arthur Keith's reference to the possibility of acquiring Darwin's house at Downe has borne fruit, for an amount sufficient to purchase and maintain the house has been offered by Mr. G. Buckston Browne, whose name will be associated with this gift to the nation

Both the University and the civic authorities have thrown themselves whole-heartedly into the work of entertaining their guests; the dinners given to the president, vice-presidents, and other prominent members of the Association by the Lord Mayor and the vice-chancellor of the University being representative of a large amount of civic and private hospitality, in which neighbouring towns have also joined. Both York and Harrogate entertained large parties of scientific visitors right royally when the week-end permitted the members of the Association to scatter into various parts of the three Ridings.

One feature in the meeting that was perhaps particularly appreciated was the effort made to provide for the comfort of members on excursions. On all general excursions, besides the leader who explained the particular points of interest, another guide accompanied each party whose sole task was to consider the comfort of visitors, and in case of any emergency to see that arrangements were made to meet it without distracting the official leader

from his duties

Both the civic reception on Thursday evening and the University reception on the night of Tuesday, were very successful, if crowded, functions. Particular distinction was given to the civic reception by the presence of H.R. H. Princess Mary, Viscountess Lascelles, to whom a number of prominent citizens, vice-presidents, members of the Council, and officials of the Association were presented. Princess Mary afterwards made a tour round a number of the beautiful rooms of the Art Gallery which were thrown open to the throngs of visitors on this occasion.

Perhaps the most striking feature of the University reception to the visitors was the vast extent and elaborate equipment of the technological departments of the University which were thrown open for their inspection with a large amount of the full scale machinery in operation. Visitors were then able to see industrial processes, such as dyeing, manufacture and treatment of leather, spinning and weaving, etc., carried out upon a manufacturing scale and at the same time worked in conjunction

with intensive scientific investigation

On Friday night a most successful dance was held in the Dance Hall of the Majestic Picture Theatre. The Lord Mayor's party, which included the president of the Association and the vice-chancellor of the University, attended after a dinner given by the Lord Mayor in the Town Hall, whilst Sir Oliver Lodge was to be seen with the party coming fresh from listening to Prof. Millikan, who had been giving the first of the evening discourses to a large audience in the Albert Hall Sir Oliver danced nearly every item of the programme, and many citizens of Leeds present on this and other social occasions of the meeting will probably have gained quite a different conception of the human side of the scientific members of the community from that usually held, as a result of this and similar light incidents of a notable scientific assembly.

SCIENTIFIC APPARATUS AND DEMONSTRATIONS.

During the week of the meeting, demonstrations were given of Mr. J. L. Baird's television and 'noctovision' apparatus The latter (which em-

ploys infra-red radiation in the place of light) is regarded by the inventor as likely to be of commercial value at an earlier date than the former, since he hopes to apply it to navigation in fog The reproductions are at present comparable with those obtained with the earliest kinematographs, and are marred by flickering and coarseness of detail, but the inventor has in view some solutions of the outstanding problems which may well prove successful, like those adopted in the earlier art. Whether or not Mr Baird will be victorious in the competition with formidable foreign rivals which lies in front of him is a matter for speculation, but at least a tribute of admiration must be paid to the ingenuity, courage, and enterprise of a British inventor who has achieved considerable success in the teeth of great difficulties. An indulgent view may therefore be taken of some aspects of the exhibits which were more relevant to the popularisation of the invention than to its technical development

An exhibition of apparatus in the crypt beneath the Reception Room formed a valuable addition to the proceedings of the Association. The exhibition was generally similar to, though on a smaller scale than, that held annually in London by the Physical and Optical Societies, and it is to be hoped that such an exhibition will become an annual feature of the meetings, since it enables scientific workers from all parts of the country to see some of the latest improvements in scientific apparatus is of course impossible to mention many of the most interesting exhibits, but a word must be said of that contributed by the Lancashire and Cheshire Coal Research Association, which included some most interesting fossil remains illustrating the natural history of coal, in addition to preparations and samples of coals and their ingredients wool research reflector for assuring even illumination in colour comparisons was attributable to the Woollen and Worsted Industries Research Association, but research associations generally did not take this opportunity of illustrating their work for the benefit of fellow investigators and others likely to be interested in it. Amongst the more recent applications of science to practical purposes, the use of an analytical quartz lamp for such purposes as the testing of bank notes and the examination of palmpsests was illustrated. The emitted radiation is restricted by a filter to a band in the neighbourhood of 3660 Å.U., and the fluorescence produced gives a sensitive indication of slight variations in the irradiated surface. Another interesting exhibit was a refrigerator without mechanical moving parts, a quantity of captive ammonia being forced through a repeating eyele of condensations and evaporations merely by the application of heat to one vessel and of cooling water to another connected with it. Refrigeration is effected by evaporation produced by mixing the liquid ammonia with hydrogen.

Visitors to Leeds this year had an opportunity of making themselves better acquainted with a medium which is already finding its place in the service of education, namely, broadcasting. Many

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people are coming to feel that what the school of to-day most urgently needs is enrichment, and this topic was the theme of many discussions in Section L (Education). In fifty years we have evolved a machine capable of high efficiency in turning out pupils reasonably well equipped for beginning to acquire knowledge, but still there are those masses who must leave school at 14 years of age with only the dimmest perception of the treasures of science and art that are their rightful inheritance. Let any one who doubts this study the text books in use in the public elementary school or hear their musical instruments or ask to see their scientific apparatus, or their playgrounds But those who see the deficiencies most acutely are in despair at the cost of providing a proper equipment under present economic conditions, and it is for this reason that they are turning their attention to a new means of enlarging the scope of a school however remote and enriching its resources without excessive cost.

At the Reception Room, some hundreds of people were able to hear the special programmes arranged by the British Broadcasting Corporation to enable schoolmasters and others to judge how clearly and naturally broadcast matter can to-day be presented in the class-room At the University a large room was divided into two parts, one of which represented a model studio, while the other did service as a class-room. A large number of members visited these rooms during the week, especially during the evening of the reception, and there were many who appreciated, perhaps for the first time, the extent to which it is possible for a speaker to project his personality into a room full of people, even when the appeal that he makes is to the auditory and not to the visual sense. Some thousands of schools are now listening regularly to these transmissions, using them to supplement the ordinary curriculum.

The new programme and syllabus of transmissions to schools and the provisional programme for adult transmissions are now ready and can be obtained from the British Broadcasting Corporation on application.

In connexion with a paper on the slaughtering of animals for food, a demonstration was given by the Royal Society for the Prevention of Cruelty to Animals in the municipal slaughter-house. After 12 pigs, bullocks, calves, and sheep had been dispatched with a captive bolt pistol (humane killer) a local butcher who was opposed to this instrument asked permission to demonstrate the use of the poll-axe on a bullock. The first blow of the axe proved ineffective, and a second had to be given before the bullock was felled.

#### TEXTILE RESEARCH.

As was fitting for a meeting held in Leeds, special provision was made for the discussion by the sections concerned of textile problems. The British Research Association for the Woollen and Worsted Industries issued a 48-page pamphlet by Dr S G. Barker and A. Frobisher dealing with its origin, constitution, and work in connexion with

the special meetings arranged for the discussion of The Association is of firms engaged directly or accessorily in the woollen and worsted industries, and its headquarters are in Leeds. Among the most debatable of textile problems is that of the 'quality' of the raw material, the fibres Judgment based upon the observations of sight and touch and crystallised by experience, grades cotton, classifies wools and tops, and selects silks with an accuracy that has sufficed for many generations of manufacturers and will no doubt continue to do so, at least to some extent, tor many years to come But science holds no realm that admits of investigation too sacred or too unfruitful for such investigation, and elasticity tests, grease estimations, diameter measurements, staple lengths, all now contribute to a more accurate, more trustworthy estimation of 'quality,' though the writers of this pamphlet wisely state that "the precise factors affecting quality as regards spinning are as yet unknown," and again, one of the outstanding problems in wool research is the investigation of the precise definition of the term 'quality'" The amount of work being done upon a determination of the measurements and properties of wool fibres may be gauged from a list of the headings under which the chemical aspects of the problem are surveyed—the action of acids, alkalis, and soaps, the estimation of alkalı and of sulphuric acid, the sulphur content; bleaching and chlorination; and the action of ammonia; and the chemical decomposition of wool at 100° C.

The physical properties of wool have also been the subject of carefully thought out investigation, and the work of Dr. Shorter, at one time on the staff of this Association, is sufficiently well known to need but mention. Since his departure, the work of evaluating the properties of wool—regarded as an amphoteric colloid—has proceeded apace, and elasticity, regain, thermal conductivity, and electrification are topics of investigation noted in the work of the Association's physical laboratory. The action of bacteria and mildews upon wool has also been the subject of, at any rate, preliminary work, though in these aspects as well as the chemical and physical aspects the work is described as "only a beginning of the attack on the great problems." "The scientific side must be closely related to the technical or trade side, and valuable as the scientific data are, yet the object of their discovery must be their application to the industry" The Association's claim that this point is ever to the fore in its work is well substantiated, and the relationship of the previously determined chemical and physical properties to such technical problems as the migration of alkali when scoured cloth is drying off from the damp state and the faults engendered thereby in subsequent processes, notably dyeing, wool scouring, the elimination of tar-marking and branding, and the all-important subject of the fading of dyestuffs, are all instances of this type of valuable work.

The comprehensive lecture delivered by Dr. S. G. Barker on the subject of the fading of

dyestuffs made it clear that here was a piece of work of which much has been done, but of which much—the greatest part perhaps—vet remains to Work yet closer to the trade processes has also been done, and apparatus likely to be of general use has been devised, the Research Association stroboscope may be mentioned in this The list of publications of the Association which, with a plan of its buildings, concludes the pamphlet, is an excellent indication of the comprehensive character of its work, and it is perhaps regrettable that the liaison between those engaged in pure science and those in technical research is not stronger and more generally No doubt wider publication of the established work of research associations might help materially in this respect.

# HONORARY DEGREES.

In a congregation of the University of Leeds in the Great Hall on Tuesday, Sept. 6, at 12 noon, the following honorary degrees were conferred:-LL.D.: Sir Arthur Keith, Conservator of the Museum and Hunterian professor of the Royal College of Surgeons of England, Her Grace the Duchess of Atholl, Parliamentary Secretary, Board of Education; The Hon. Sir Charles Parsons. D.Sc.: Prof. J. S. Haldane, honorary professor and director of the Mining Research Laboratory, Birmingham University; Dr N. V. Sidgwick, reader in chemistry in the University of Oxford, Prof F. O. Bower, emeritus professor of botany in the University of Glasgow, Dr. R. A. Millikan, chairman of the Executive Council of the California Institute of Technology and Director of the Norman Bridge Laboratory of the Institute. Ph.D.: James Graham, Director of Education, Lecds

#### REPORT OF COUNCIL.

The report of the Council presented to the General Committee on Aug. 31, expresses profound gratitude to Sir Alfred Yarrow for his munificent gift of £10,000 to the funds of the Association for general purposes, and accepts the wise condition that the gift should be expended as to both capital and interest within twenty years.

The Council has had under discussion with the Board of Trade the question of the duty required

by H M Customs on the introduction of kinematograph films into Great Britain for scientific purposes and not intended for commercial uses. The matter was referred to the Lords Commissioners of H M. Treasury, from whom a reply was received that "having regard to the impracticability of framing a statutory exemption which would be free from grave difficulties of definition and administration," they were unable "to submit to Parliament proposals of the nature desired by the Association."

Reference is made in the Council's report to the two conferences called to consider the possibility of establishing a Science News Service—The essential condition for success of such a scheme is that scientific societies and institutions themselves

should desire its organisation.

In view of the lack of unanimity and of enthusiasm evenced at the two conferences, the committee appointed to indicate the ways in which this support might be given, considers that no useful purpose would be served by communicating with the scientific societies. The opinion is expressed, however, that should sufficient funds be forthcoming for the establishment of a Science News Service, the Council of the Association—possibly in co-operation with the British Science Guild—might appropriately undertake the organisation of the service.

The Council has had under consideration the question of inviting "the co-operation of the British Science Guild in considering whether, having regard to the close community of scientific interests between the Association and the Guild, their objects would, as the Council believe, be more fully attained by means of a working union between the two societies; and if so, by what means such umon would best be given effect." A joint committee of the two bodies has prepared a report in which the general methods by which such a fusion might be effected are stated. This report came before the General Committee of the Association on Sept. 6, when it was decided that the Council be authorised to continue the negotiations and report to the meeting of the General Committee at Glasgow.

Next year's meeting of the Association will be held at Glasgow under the presidency of Sir William Bragg. The meeting in 1929 will be held in South Africa, and invitations have been received to meet at Bristol in 1930 and Leicester in 1932.

# Obituary.

PROF. H. R. PROCTER, F.R.S.

HENRY RICHARDSON PROCTER, born at North Shields in 1848, was the son of a tanner, a member of the Society of Friends. He was educated at Bootham School and received his scientific training at the Royal College of Chemistry and the School of Mines. He entered the tanning industry and remained on Tyneside until 1891, when he was invited to the Yorkshire College, Leeds, to take charge of a new department to be opened there in the special interest of the leather industry. In this Procter achieved distinguished success, and his work

afforded as fine an example as could well be cited of the part which applied science may properly take within the circle of university studies. Students came to Procter from all parts of the world. He was a thorough man of science, an eager and fruitful investigator, and an excellent teacher. He gave to the industry the means of scientific control and development in many directions, and placed his discoveries freely at its disposal. His text-books have long been the standard works in the science of leather manufacture.

Though Procter's scientific studies were centred

upon the problems of the leather industry, he revelled in pursuing their general theoretical bearing, and wherever they carried him he read himself in with great thoroughness It was typical of his mental proclivities that he should have been the translator of the first text-book of practical physics -Kohlrausch's—that found general use in physical laboratories in Great Britain. His later researches on gelatine were of fundamental importance and exhibited his power of dealing with the most abstruse problems of colloid chemistry

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Beyond this, Procter was a man of wide culture, keenly interested in languages, literature, and philosophy. He was an excellent countryman and had much of the artistic sense which has appeared

so strongly in his sons

The value set upon Procter's work was so great that when the time arrived for his retirement, a movement took place for the establishment of a research laboratory which should serve as a memorial and as a place where he could continue his investigations This project secured international support, and in 1914 Procter became the first honorary director of the international research laboratory at Leeds bearing his name The honour done to Procter was fully earned by the scientific and industrial value of his labours, but it was intensified by the respect and affection in which he was held for his personal qualities His fine character, his devotion, unselfishness, and modesty, together with his great companionableness, endeared him alike to his pupils, his colleagues, and the members of the industry to which he rendered such memorable service.

Procter was elected fellow of the Royal Society in 1923 and received the honorary degree of D.Sc. from the University of Leeds honorary president of the International Association of Leather Trade Chemists, of which he was a founder, and he received the freedom and livery of the Leathersellers' Company. He died on Aug 17 at Newlyn, Cornwall, where he lived in happy retirement after leaving Leeds.

### Prof. E. B. Titchener

THE announcement of the death of the English psychologist, Prof. Titchener, in his sixty-first year, which occurred after a short illness at Ithaca, N.Y., on Aug. 3, will be received in Great Britain with mingled feelings of regret and surprise. Regret will be felt for the loss of one who spent his abundant energies so generously in nursing to adolescence a new-born science. Surprise will be felt at the tidings that Titchener remained an Englishman, despite his thirty-five years' residence at Cornell University, and that with his full record of work he had only attained the age of sixty years at the time of his death.

Edward Bradford Titchener was born at Chichester on Jan. 11, 1867. From Malvern College he entered the University of Oxford in his nineteenth year, where he became a classical scholar at Brasenose, obtaining first class both in Moderations in 1887 and in Literae Humaniores in 1889. He took his BA in 1890, his MA in 1895, and in 1906 he was awarded the degree of D Sc at that University. From classics and philosophy he passed to the study of physiology at Oxford, and worked there as a research student during the year 1889–90. Attracted to experimental psychology, he proceeded to Leipzig, where he studied under Wundt and obtained the Ph.D. degree in 1892. Returning later in this year to Oxford, he began to inquire into the possibility of obtaining a permanent teaching post in experimental psychology, while he was giving university extension lectures in biology He was advised by Burdon Sanderson, however, that there were no immediate prospects in England, and consequently he accepted the immediate offer of an assistant professorship in psychology at Cornell.

Here from 1892 onwards Titchener spent the remainder of his life In 1895 he was made Sage professor of psychology, and in 1910 his professorship became attached to the Graduate School of the University. His specific aims at Cornell were to emancipate psychology from the leading-strings of philosophy, to establish undergraduate, as well as post-graduate, instruction, to compile a graded series of text-books in psychology, and to organise laboratory research in the subject His achievement of these aims was indeed remarkable twelve years he had established a completely independent department of psychology, in which finally he had a staff of two professors, two instructors and He had an annual entry of nearly three assistants one thousand undergraduates. In 1896 he published "An Outline of Psychology" (replaced in 1910 by his "Text-book of Psychology"). In 1898 his "Primer of Psychology" appeared (which in 1915 was replaced by "A Beginner's Psychology"). In 1908 his book on "Feeling and Attention" was published, followed in 1909 by "The Experimental Psychology of the Thought Processes "

Titchener's magnum opus, however, a thirteen years' task, the financial cost of which, he used to say, nearly ruined him, was his "Laboratory Manual of Experimental Psychology," issued in four volumes during the years 1901-5. While preparing this monumental work, he devised and standardised many useful pieces of apparatus for laboratory teaching. It was translated later into most European languages, and into Chinese and Japanese. It was the source of many later more elementary text-books, and it led to requests for his help in planning psychological laboratories in

practically every part of the world.

In 1917 a commemorative volume of essays, marking the close of twenty-five years' teaching work at Cornell, was presented to Titchener by his friends and students. By the end of 1923 the number of his published articles had amounted to 190, while the papers issuing from his students (for which he was personally responsible) numbered 158. From 1894 until 1920 he acted as American editor of the British philosophical periodical, Mind, and during the years 1894–1925 he was associate editor, and finally editor, of the American Journal of Psychology.

Titchener's unbounded energy and his abilities

were suitably rewarded in the United States. became Lowell lecturer at Cambridge, he was invited to give special courses of lectures at Columbia, Illinois, and elsewhere He received the honorary degrees of D Sc at Harvard, Litt D at Clark, and LL D. at Wisconsin. But throughout he remained a loyal British citizen and faithful to Cornell, refusing posts and honours that would have involved a change of nationality or a change of resi-He was offered, but declined, not only the chair of psychology at Harvard on Munsterberg's death, but also the presidency of Clark University, which became vacant on the retirement of Stanley Hall As an Englishman, he could never be a candidate for admission to the U.S. National Academy of Sciences.

Though, however, so loyal as to nationality, Titchener's psychological sympathies ever centred around Wundt, in whose laboratory at Leipzig he had received his first introduction to experimental psychology. His attitude towards his students and his organisation of laboratory work were also typically German. His admiration for Wundt led him to translate into English the third edition of the "Physiologische Psychologie" Takıng his manuscript to Germany, he found that Wundt was already issuing the fourth edition of this large work. Titchener set himself forthwith to make a translation of the fourth edition, only again to find on its completion that he had been overtaken by the fifth edition. Still undaunted, he began to translate the fifth edition, and he finally published a part of this translation. He also translated Kulpe's "Outlines of Psychology." At the time of his death he was engaged on a work of his own, which he hoped to issue in the form of a "Systematic Psychology" in three or four volumes, the first of which he had practically completed before he passed away.

Titchener's married and domestic life was an exceptionally happy one. His home on Cornell

Heights was delightful to visit He suffered from all the virtues and failings of an unusually emotional He was unduly sensitive to neglect temperament or injustice, and he did not easily brook any disagreement from his psychological views, especially on the part of his students and staff - On the other hand, no one could surpass him in kindness and generosity to his friends—He spent practically all his time in the laboratory or in his home, he was so rarely seen in the streets that it became a standing joke as to how he passed from one to the other. During his last years he began to form a collection of Oriental coins, which with his usual thoroughness he made one of the finest in America, learning Arabic in order to be able to read their inscriptions He was interested in music, and during the years 1896-98 he acted as professor in charge of music at Cornell University.

# WE regret to announce the following deaths

Sir John Benton, K.C.I.E., formerly chief engineer and secretary to the Government, Panjab Irrigation Branch, who was responsible for many of the great canal and irrigation schemes of the Panjab and Upper Burma, on Aug. 29, aged seventy-seven years.

Prof. C. Pulfrich, of the Zeiss optical works, Jena, the author of numerous publications dealing with his investigations with the spectrometer and refractometer,

aged sixty-nine years.

Dr. Henry P. Talbot, for many years professor of analytical chemistry in the Massachusetts Institute of Technology, and a vice-president of the American Association in 1907, on June 18, aged sixty-three

Prof. Stuart Weller, professor of palæontological geology in the University of Chicago, who specialised on the faunas of the Mississippi valley, on Aug. 5, aged

fifty six years.

Dr. William P. Wilson, formerly professor of botany at the University of Pennsylvania, and since 1894 director of the Philadelphia Commercial Museums, on May 12, aged eighty-two years.

### News and Views.

THE Government scheme for linking up the Dominions with Great Britain by radio telegraphy has now been completed by the opening of the short wave beam stations to India. The fact that the Indian beam stations can work at high speed continuously for many hours during the monsoon period shows that the beam receiving aerials are little affected by atmospherics. The English transmitting station is at Grimsby and the receiving station is at Skegness, which are both in direct communication with the Central Telegraph Office of the G.P.O in London. The corresponding transmitting and receiving stations in India are at Kirkee, near Poona, and Dhond, 48 miles east of Poona, which are both linked directly with Bombay. Transmission from Grimsby to India takes place on wave-lengths of 16 2 and 34 5 metres (about 18,500 and 8700 kilocycles per second respectively). At Grimsby a five-mast aerial system, quite distinct from the three-mast aerial system of the Australian service, has been built. The masts are

277 feet in height with a distance of 650 feet between them. They are erected in a straight line which cuts at right angles the great circle passing through Grimsby and Dhond. The reflector behind the active aerials focusses the waves in a south-easterly direction on to the receiving aerials in India. A similar system has been built at Kirkee to concentrate the waves in a north-westerly direction towards England. Within a few weeks' time the Marconi Company will maugurate a commercial beam radio service between Great Britain and South America and also one with the United States. Experiments have proved that it is possible to carry on radio telephony simultaneously with high-speed radio telegraphy There is every prospect, therefore, that before the end of next year, it will be possible for telephone subscribers in England to call up subscribers in any of the Dominions overseas.

The celebration, on Aug. 30, of the golden wedding of Prof. H. E. Armstrong and Mrs. Armstrong was

made the occasion for the presentation to them of the portrait of Prof. Armstrong by Mr. T. C Dugdale, exhibited in this year's Royal Academy. The presentation was made at a reception held at the house of Dr. Stephen Miall and Mrs. Miall, son-in-law and daughter of Prof. and Mrs. Armstrong. With the portrait was presented an illuminated album signed by the subscribers, among whom are a number of

leading workers ın diverse departments chemical science. We are glad to be able to reproduce a photograph of the painting (Fig. 1) The address which accompanied it reads as follows:

"PROFESSOR AND M R SHENRY EDWARD ARMSTRONG. Your Staff and Students of Chemistry of former years greet you with affectionate 1egard on this happy occasion of your Golden Wedding. As they are scattered all over the world, only a comparatively small body of them can subscribe to this personal Letter of Greeting, but in so doing, and in endeavouring to honour their Chief and his Lady, they

know they are voicing the good wishes of all They know, Professor Armstrong, their Colleagues. that by your teaching, your breadth of vision, and your scientific use of the imagination, coupled with a sympathetic guidance and a real human understanding, you have inspired those who have been privileged to work with you to their lasting benefit The consciousness of this grows with them; so, with perhaps a pardonable pride, they have purchased your portrait in this year's Royal Academy to mark the present occasion. They ask your acceptance of this portrait for the period of your lives, earnestly trusting that such useful lives may long be spared. Eventually, however, they propose presenting it to

one of the London learned Societies in commemoration of a striking personality and as a lasting record of their appreciation and affection "

The installation of receiving sets for broadcasting has familiarised many with the idea of what electricians mean by an 'earth.' The subject is sometimes eagerly discussed by amateurs, and the difficulties

experienced by

FIG 1 -Prof Henry E Armstrong, F.R S From a painting by T. C. Dugdale

those who installed lightning conductors many years ago are again being considered. For earthing the conduits used for protecting electric light wires, the Institution of Electrical Engmeers is carrymg out experiments so as to enable a good method of earthing to be speci-In the fied. Electrical Review for Aug. 19, some suggestions are made for improving the methods of earthing electric lighting systems used at both generating and substations. In this case a very large earth curient may flow if a fault develop in the system and it is necessary to make the joints and connectors large. permanent, and

trustworthy. The resistance of the path in the earth varies with the composition and the moisture content. In dry weather it is often fifty times as great as in wet weather. Sometimes, when permanently damp soil cannot be reached, a pipe is run into the ground near the earth connexion and water poured into it in dry weather. It is known that the resistance of the 'earth' increases very rapidly at the freezing point. In Great Britain, however, it is unlikely that earth plates are likely to be buried in soil which is ever frozen. Iron pipes an inch in diameter can be used successfully to form an earthing system. Unless the ground is rocky, they can be driven into it until damp'soil is reached. It is very seldom that a depth of 20 feet is necessary. A number of these pipes about four feet apart and connected in parallel form a suitable earth for a supply network. Tests should be made to see whether the earth is capable of carrying the maximum possible 'fault' current. It is quite possible for an arc to form between loosely packed pieces of carbon and so melt the soldered connexions. Hence periodical tests should always be made.

THE rapid development of electric signs during the last few years has made many think that a more rigorous censorship of sententious texts and childish pictures is desirable. It shows the belief that advertisers have in the efficacy of continued repetition. In the July issue of Progress, published by the Allgemeine Elektricitats-Gesellschaft of Berlin, there are interesting articles on electric signs and the flood lighting of buildings. A successful method of attracting attention, which is rapidly becoming popular, is to have an instantaneous time indicator, the large figures giving the time being controlled by a master clock. Stress is also laid on the importance of arranging the signs so that they are visible in daylight. Neon tubes seem specially suitable for the purpose. They are rather expensive to buy, but the saving of electricity during the first year by their use more than covers their cost. There can be no doubt, however, that the appearance of a street at night can be improved by 'flooding' beautiful buildings in it with light. Examples of flood lighting have been familiar to dwellers in London for many years, and we think that they provide a pleasing and unobjectionable method of advertising. Some interesting photographs shown in Progess of the effects that can be produced at no great expense by flood lighting. In particular we would mention the Cathedral and banks of the Rhine at Bâle. The flood lighting also of St. Mary's Church at Lubeck shows up excellently against the dark background. In Germany, many municipal authorities and tramway companies grant permission readily to shopkeepers and others to mount cheap projectors for flood light purposes on the tramway and lighting poles.

EVER since the last attempt to reach the summit of Mount Everest in 1924, Italian climbers have been planning an expedition with the same end in view. The Times reports that the plans of the Italian expedition are now complete. The expense is to be borne by the city of Milan and the expedition is to be organised by the Mılan Alpıne Club. The Italians propose to approach the mountain from the Nepal side, which will necessitate the approval of the rulers of Nepal. This has hitherto been refused for any attempt on Mount Everest. If the veto is not removed, the Italian expedition proposes to make its object Mount Godwin-Austen (K2) in Kashmir, which is about 28,250 feet in height, and is said to offer difficulties fully as great as those of Mount Everest.

DR. DOROTHY JORDAN LLOYD has been appointed director of research to the British Leather Manu-

facturers' Research Association in succession to Dr. R. H. Pickard. Dr. Lloyd has been a member of the staff of the Association since its inception and has published papers on the chemistry of gelatine Dr. Pickard's services will be retained for a time as consultant-director.

IT will be recalled that a Lister Centenary Exhibition was arranged at the Wellcome Historical Medical Museum, 54A Wigmore Street, in connexion with the centenary celebrations in London in April last. The Exhibition has already been visited by a large number of visitors from all parts of the world, and will remain open until Oct. 1.

The July issue of The Fight against Disease, the journal of the Research Defence Society, contains a short obituary notice with excellent portrait of the late Prof. Starling, who gave unceasing support to the Society, and a report of the first Stephen Paget Memorial Lecture by Prof. Julian Huxley, entitled "Research and the Community." Quoting examples of the control of plant and animal pests by biological methods, of the breeding of strains of wheat immune to rust, and of the control of many human diseases, Prof. Huxley emphasised the importance of research to the whole community.

The new Radiological Department of the Royal Infirmary, Edinburgh, was opened last October and is under the charge of Dr. J. M. W. Morison. A description of this department has been issued in the form of a brochure by Messrs. Watson and Sons (Electro-Medical) and will repay study by those interested in the lay-out and equipment of a radiological department, one of the most vital in the needs of a big hospital. There are others also to whom it may be of interest as showing the extent to which electro-technical invention is used by radiologists at the present time. The plans of the building are reproduced by courtesy of the architect, Mr. T. W. Turnbull.

The Report of the Director-General (Mr. Robert Dick) of Public Health, New South Wales, for the year 1925, which has recently been issued, contains a record of the public health administration, communicable diseases and industrial hygiene of the State, and a report of investigations conducted in the microbiological laboratory. Dr. Badham describes an explosion in a sugar-refining factory which caused three deaths. The explosion was caused by the ignition of sugar dust, apparently by the breaking of the bulb of a portable electric lamp, while the men were clearing an accumulation of sugar dust from a dust-collecting system. A few explosions in flour mills caused in the same manner have been recorded.

THE Section of Geodesy of the International Union of Geodesy and Geophysics has recently issued Tome 2 of its *Travaux*, containing general reports prepared in connexion with the Rome assembly in 1922, though not then presented. They refer to the period 1912–1922, between the last meeting of the old International Geodetic Association at Hamburg, and

the Rome meeting of the new organisation, and may be regarded as continuing the triennial reports presented to its predecessor. The volume is of considerable size, the principal contents consisting of a comprehensive report on determinations of latitude, azimuth, and longitude, prepared by H. L P Jolly, research officer to the Ordnance Survey; a report by E. de Martonne on the 1913-1914 campaign of geodetic astronomy executed by the geographical survey of French West Africa; and a report by E. Soler, professor of geodesy at Padua, on relative measures of the intensity of gravity in all parts of the world. There are also shorter reports by G. F. Dodwell on radio determinations of longitude in Australia, and by J. de Graaf Hunter on deviations of the vertical.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A man or woman on the staff of the Association of Special Libraries and Information Bureaux to compile supplementary data for the "Aslib Directory of Sources of Specialised Information"—The Secretary, Aslib. 38

Bloomsbury Square, W.C.I (Sept. 15). A lecturer in mining at the Denbighshire Technical Institute, Wrexham-The Secretary and Director of Education, Education Offices, Ruthin (Sept. 17). A temporary assistant lecturer in education at the University College of Swansea—The Registrar, University College of Swansea, Singleton Park, Swansea (Sept. 20). A deputy director of agriculture under the Government of the Punjab - The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, SWI (Sept. 24). An assistant examiner of Questioned Documents under the Government of India, with knowledge of chemistry, especially analytical chemistry, and of physics and photography-The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (Sept. 26). A mycologist for research at the Imperial College of Science and Technology on wood-destroying fungi-The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Sept. 26). Civilian education officers of the Royal Air Force, with practical qualifications for teaching engineering subjects—The Secretary, Air Ministry, Adastral House, Kingsway, W.C 2.

#### Our Astronomical Column.

An Extremely Massive Multiple Star.—The star 27 Canis Majoris has been examined spectroscopically by Dr. O. Struve, and found to be a most interesting quadruple system. His results, which are published in the Astrophysical Journal, vol 65, p. 273, show that two independent spectra are visible. These are of types B5ne and B8, and correspond to the two principal components of the system, which have a period of revolution of 3.2 years. Each of these components has, in addition, a much shorter period, indicating the presence of invisible companions. The masses of the stars in this system are found to be unusually large, the minimum value of the total mass being 950 times that of the sun. The masses of the two principal pairs (A+B) and (A+B) and (A+B) are approximately equal, but the ratios (A+B) and (A+B) are not known. The mass of each star, however, must be in the average at least 238 times the solar mass. Attempts to attribute the line shifts to causes other than radial velocity are very unsatisfactory, and there seems at present to be no alternative to the acceptance of these enormous masses.

Tables for Ephemerides in Parabolic Orbits.—Some years ago a modification of the familiar equations, due to Gauss, that give the rectangular heliocentric co-ordinates x, y, z, was published; in this the co-ordinates are given in terms of  $\tan v/2$  and  $\tan^2 v/2$  multiplied by factors deducible from the elements of the orbit. Mr. Bengt Stromgren has calculated useful tables, which are published in Meddelelser fra Kobenhavns Observatorium, No. 58, and in B.A.A. Memoirs, vol. 27, Part 2. These give the natural values of  $\tan v/2$  and its square, the argument being M, which is the interval from perihelion in days multiplied by  $q^{-1}$ . The values are given to five decimal places, so they suffice for fairly accurate ephemenides, but not for rigorous ones. They extend to  $120^{\circ}$  from perihelion; comets are seldom observed farther than this unless q is very small. The tables are designed for use with a calculating machine, and will considerably reduce the labour of forming an ephemeris

STARS WITH BRIGHT IRON LINES.—Among the emission lines which are found in stellar spectra, the lines of iron occur more frequently than those of any other element except hydrogen. Stars in which these lines are found may be divided into four groups, namely, long period variables, peculiar stars of late types, stars of type Be, and novæ. In the Astrophysical Journal, vol. 65, p. 286, Dr. Merrill gives list of stars showing bright iron lines in the general and of stars showing bright iron lines in the second and third of these groups, as well as discussing all the available information concerning them. One point of great interest which emerges from this discussion is the fact that only the lines of ionised iron appear as emission lines in the majority of stars. This is the case even in the low temperature stars which possess very strong are lines in their absorption spectra. The only stars in which emission lines of the neutral atom occur are the long period variables, and even in these cases enhanced lines are also present. It also appears that bright iron lines are found mainly in stars near the two extremes (B and M) of the temperature sequence, being absent in types A and F.

REPORT OF THE ROYAL OBSERVATORY, CAPE OF GOOD HOPE.—The annual report for 1926 of the Royal Observatory, Cape of Good Hope, has just been issued. The meridian observations include all stars south of Decl. – 30° down to mag 7.5. Heliometer observations of planets are also being made. Dr. J. Lunt, who has been using the Victoria telescope for stellar spectroscopy for thirty years, has now retired; a programme of stellar parallaxes with the instrument has been commenced. The Cape section of the Astrographic Catalogue is now almost complete, the last volume being in type. It is noted that the number of meridian observations and of solar photographs are in excess of any previous year. A new clock, Shortt No. 10, has been obtained from the Synchronome Co., and is working satisfactorily. A radio time signal is sent out daily for the use of shipping in South African waters; another one is distributed three times daily by the local broadcasting association.

# Research Items.

THE ORIGIN OF THE MASAI —In the Journal of the East Africa and Uganda Natural History Society, No. 28, Mr. C. L. Bolton criticises the theories on the origin of the Masai and other non-Bantu races of Kenya and Uganda which were advanced by Mr. C. C. Luck in the *Journal* for August 1926. Mr. Luck suggested that the Masai were the descendants of the half tribe of Manasseh from the west of Jordan and the Nandi of Moab, and that there were many proofs of the influence of the ancient civilisation of Egypt-Mesopotamia in Central Africa. Mr Bolton maintains, however, that Sir Charles Eliot's arguments against the Semitic origin of the Nilotic languages have never been met, while physically the Masai and Nandi exhibit none of the signs of a Semitic cross. The cultural evidence collected by Mr. Luck points to Egyptian influence. In addition, spitting for luck and on meeting a person is characteristic of the Mediterranean peoples, and dislike of swine, bewitching by means of anything from the body, aversion from the use of proper names for fear of witchcraft, the sun worship of the Nandi and the possible derivation of L'Oibon from the word for snake and wizard also point to Egypt. The Mosaic traditions noted by Merker may have originated in Egypt before the Jews left the country and hence reached central Africa, or they may have been introduced by Mohammedans or even by Jews trading up the Nile. As an alternative theory of origin, it is suggested that the Somali and Galla are the lineal descendants of the Macrobians of Herodotus, and as independent but unambitious people may have inhabited their present country possibly for thousands of years. The Masai and Nandi may be of Bantu stock crossed with a race from Egypt, possible the Automoli of Herodotus, perhaps themselves a mixed race who drove the Bantu peoples out and took their women. These Bantu still exist as the Wakamba, Kikuyu, and Kitosh. The Bahima appear to be Hamitic negroes with a dash of Aryan blood which may be due to a Persian infiltration of adventurers at the time of the conquest of Egypt by Cambyses.

BRITISH GALL MIDGES OF ECONOMIC IMPORTANCE —The Journal of the South-Eastern Agricultural College, Wye, No. 24, July 1927, contains an important paper (pp. 65-146) by Mr. H. F. Barnes on British Cecidomyidæ or gall midges. In this memoir Mr. Barnes has gathered together all the essential information concerning these insects, while new and unpublished observations are also added. Under each species is given the original description (or, sometimes the first available one), its distribution, biology, control measures and parasites, wherever sufficient data are available. At the end of the paper there is a hibliography containing about 380 references and a useful index both of gall midges and of the plants which they affect. A comprehensive summary of this character, particularly in so obscure a family as the C'ecidomyidæ, is particularly valuable to all engaged in agricultural and horticultural entomology, as well as to the general entomologist. Workers on this group of flies are extremely few throughout the world, and Mr. Barnes is doing good service in exploring the family so thoroughly. It may be mentioned that the present paper treats of the midges, the larvæ of which affect cereals, fodder crops, fruit, vegetables, and miscellaneous plants. It is the author's intention to supplement it later by additional parts dealing with the midges which attack trees and shrubs, together with others that are predaceous in habit and, therefore, beneticial. Copies of the paper under notice may be obtained at a charge of 3s/6d post-free from the author, Rothamsted Experimental Station, Harpenden, Herts

INVERTEBRATES FROM THE SPITSBERGEN BANKS. In an investigation into the bottom fauna of the banks around Spitsbergen, undertaken in the summer of 1925 and 1926 by the Tovik and Armauer Hansen, Dr. James A. Grieg gives an account of the invertebrates from the bottom, and the stomach contents-of certain fish eaught ("Evertebrater fra bankerne ved Spitsbergen indsamlet av Tovik og Armauer Hansen somrene 1925 og 1926. Fiskenaering og bundfauna." By James A. Grieg. Bergens Museum Aarbok, 1926. Naturvidenskabelig rackke Nr. 5). Besides a few smaller fishes the stomach contents of Gadus callarias, G. aeglefinus, and G. saida weve investigated, a long list of invertebrates being given for the two first mentioned, including many molluses, crustacea, echinoderms, and annelids. A photograph shows the contents of the stomach of a specimen of Gadus acylefinus, 75 cm long. This food weighed 675 grams and meludod 6 living Mya truncata (44-52 mm. long) and 4 dead (49-59 mm. long). In addition to these were several other molluses, Balanus shells, worms, echinoderms, and miscellanea. On the whole, the molluses, crustaceans, worms, and echinoderms seem to be eaten indiscriminately by both cod and haddock. The erab Hyas arancus is common. There were several with eggs, and it was found in numbers inside the cod. Hyas coarcticus, so far only recorded once before from Spitsbergen, also occurred. Pandalus borcalis was plentiful, bearing eggs in August. The bottom fauna of these regions consists of representatives of nearly all the large groups, including among the mollusca four species of Neptunea, the whole forming a good feeding ground for the fishes.

FISHING GEAR OF ENGLAND AND WALES. A revised edition of Mr. F. M. Davis's excellent account of the fishing gear of England and Wales has recently appeared. (Min. Agric. and Fish., Fish. Invest., Sor. 2, Sea Fish., vol. 9, No. 6, 1927. London: 11.M. Stationery Office. 5s. 6d.) Several additions have been made, including a description of the Danish plaice seine, or snurrevaud, and of such more recent forms of trawling appliances as the Vigneron-Dahl trawl, the Rowton 'stream line' trawl, and the French extenseur, which consists of a buoyant otter board to which is attached a heavy weight. The important experimental work carried out by Taylor and Wells in America and followed up by Atkins in Great Britain, on the use of copper elente as a net preservative, is also described. An enlarged bibliography, conveniently classified, includes references to accounts of foreign fishing gear and to a number of the more interesting historical treatises. The illustrations appear to be identical with those of the first edition, but their new arrangement as text figures inserted in appropriate positions has added considerably to their usefulness.

MUTATIONS IN HAPLOID DATURA.—The haploid Datura which was obtained by treatment with cold at the time of embryo-sac development has since been propagated by cuttings, and a completely homozygous  $\mathbf{F}_1$  has been obtained by self-pollination, as a few good pollen grains and eggs cells with twelve chromosomes are produced. Messes. Blakeslee, Morrison, and Avery (Jour. of Heredity, vol. 18, No. 5)

have studied the offspring of such plants and have obtained in the second generation a mutant in which the cotyledons have the peculiarity of being closely curled. The life cycle is otherwise normal. By crosses with trisomic (2n+1) forms, it is found that this gene mutation is in the same chromosome which produces the 'Poinsettia' type when present in triplicate. This chromosome also contains the factors for purple or white flower. There is therefore linkage between curled cotyledons and white flower, and the amount of crossing over between them is found to be about 12 5 per cent. Another mutant of even greater interest, from descendants of the haploid, is called 'tricarpel,' since the flowers have three or sometimes four carpels instead of the usual two. The other flower parts are correspondingly increased in number, the leaves are narrower, stems more slender and often triforked. The changes in the flower are really of generic value. The gene for this mutation is found to be in the chromosome which produces 'reduced' when present in triplicate The fact that these two mutations have appeared in the offspring of a necessarily homozygous haploid plant is emphasised as supporting the view that crossing is not necessary for the production of gene mutations. Their frequency (2.31 per cent. if two other unstudied mutants are included) indicates that the homozygous condition does not hinder occurrences of mutations.

PLANT GROWTH AND REACTION CHANGE IN CULTURE Solutions —Dr. Tsung-Lê-Loo records some interestmg experiments on the change of reaction in neutral salt solutions in contact with the root systems of living plants (Japanese Journal of Botany, vol 3, No. 3, 1927). The phenomenon was thought by previous workers (Czapek and Nathansohn) to be due to the excretion of acids or alkali by the roots The change in reaction is, however, too great to be ascribed to root excretion, and is now generally accounted for by the unbalanced absorption of amons and cations. In the present series of experiments, ammonium salts of morganic acids were used as the source of nitrogen, the experimental plants including Zea mais, Fagopyrum esculentum, and Oryza In contact with the roots of the culture plants the reaction of solutions containing ammonium nitrate, chloride, and sulphate respectively, became considerably acidic, the order of the change being from 1.3 to 1.8 of pH in two weeks. In the case of solutions containing sodium nitrate the reaction became more alkaline, the pH changing to a similar degree With ammonium monohydrogen phosphate and ammonium bicarbonate little change in reaction was noted. The increase in hydrogen ion concentration in solutions containing ammonium salts generally produced poor growth of the culture plants with the exception of paddy rice and buckwheat, which are evidently tolerant of an acidic medium. The slow and slight change in the case of phosphate solutions promoted favourable growth. A combination of two salts such as ammonium chloride and bicarbonate used as a source of nitrogen instead of a single salt, gave better results, and the fluctuation in growth ran parallel to the change in the reaction noted.

Sources of Underground Water.—Prof. J. W. Gregory, in a paper read to the recent summer meeting of the Institution of Water Engineers at Glasgow, combats the common view that all underground water is derived from percolating rain. He affirms that the plutonic water set free in the cooling of the earth's crust was sufficient to fill the oceans to their present level irrespective of meteoric water, and he sums up the position by saying that subterranean water comes from three sources—rainfall, which soaks

underground year by year, connate water, which is stored up in the beds at the time of their deposition, and plutonic water, which rises from the interior of the earth, and appears at the surface for the first time. This threefold origin complicates the distribution of subterranean water. Meteoric water, including both contemporary rainfall and connate water, is expected in permeable sedimentary rocks at depths not too great for the heat to debar the descent of water, or in which it is securely imprisoned, and though-joints, which may occur in rocks of any kind, may be used for storage, useful supplies of meteoric water are as a rule confined to sedimentary rocks or to vesicular igneous Plutonic water, on the other hand, may have a more varied distribution, for during its ascent it may force its way into any overlying rock which contains spaces available for water-storage.

Fossil Insects —Parts 8 and 9 of Dr. R. J Tillyard's series of papers on the Kansas Permian insects deal with the Copeognatha and Hemiptera (American Jour. Sci., 5, 11, 315, 381; 1926). The familiar forms of the Copeogratha are the wingless species known as 'book-lice' or 'cabinet-lice.' The geological record of this order is very imperfect Hitherto the only fossil forms known were found in the Oligocene (Baltic amber and Tertiary opal), but morphological evidence indicates that the order is an ancient one, and this has now been proved by the discovery of specimens, belonging to eight genera, in the Lower Permian of Kansas. These early forms, as might be expected, differ in many respects from their Oligocene and living descendants. The Hemiptera until recently were not known before the Lias, but during the last few years it has been shown that they were abundant in Australia in Triassic and Upper Permian times. Dr. Tillyard has now recognised four specimens in the Lower Permian of Kansas, and considers that they were derived from the more primitive forms of the Copeognatha. In a paper on the Upper Permian Insects of New South Wales (Proc. Linn. Soc. N. S. Wales, 51, 265; 1926), Dr. Tillyard describes new forms belonging to the orders Mecoptera, Paramecoptera, and Neuroptera. The remains of the case of a caddis larva from the Lower Eccene of Tennessee are described by Prof. E. W. Berry (Proc. U. S. Nat. Mus., 71, art. 14, 1926).

BITUMINOUS SANDS OF ALBERTA.—The Scientific and Industrial Research Council of Alberta has issued a report on the famous bituminous sands, by Messrs K. A. Clark and S. M. Blair, dealing mainly with the occurrence of these resources; two further reports are in course of preparation, one on the separation of bitumen from the sand, and the other on its utilisation. Although this report is well put together and contains much detailed information and good illustrations, we are rather at a loss to know why it should have been necessary to duplicate to such an extent the almost exhaustive work of S. C. Ells of the Mines Branch of the Canadian Department of Mines It was only a year ago that an excellent memoir by that author appeared, though according to the present authors their work was planned to supplement that of the Mines Branch at Ottawa. The whole problem of these bituminous sands is that of their commercial utilisation; as potential sources of bitumen for road-making and similar purposes, they are admittedly of great value, but until an effective and cheap method of separation is devised, they lose much of their economic attraction. It is gratifying to note, therefore, that the authors have given this phase of the subject their careful attention and that still further investigations in this direc-tion are in progress. They state that the hitherto inefficient method of hot-water separation has been developed to give very satisfactory results, which, in view of the cost of transporting the raw material, is important, since it means that the bitumen can be extracted at the source and dispatched within and without the Province as a marketable product. Herein lies a solution to at least one of the difficulties which have so far confronted commercial exploitation on a large scale, on the other hand, present industrial conditions may be unfavourable to extensive development, and any new stimulus, as Mr. Ells pointed out previously, may be somewhat artificial.

PHILIPPINE COAL RESOURCES.—In The Philippine Journal of Science for May 1927 there is a succinct but clearly drawn picture of coal mining in the Philippine Islands. It is pointed out that coal deposits exist practically all over the Islands, but that the deposits are small, patchy, and megular, the coal being either lignitic or sub-bituminous seams of coal are known, but only five are being worked, the thickness of the latter ranging from 30 cm. to about 4 m The author records 18 different localities at which coal is worked, and there appear to be very many others. Nevertheless, the total tounage of coal is estimated by him as only 21,200,000 tons, and the total production for the period 1842-1924 as 412,280 tons; only two localities have produced more than 100,000 tons within that period. The importation of coal during 1908–1924 has averaged close on 500,000 tons per annum. At present the local production does not exceed 50,000 tons per annum, and the author looks upon 100,000 tons as the probable limit It is, therefore, clear enough that the coal production of the Philippine Islands can have only a local interest.

THE HELIUM MOLECULE -- The substance He. appears to be more stable than has been supposed. It is still only known from its spectrum, and cannot be isolated, but W. Weizel and C. Fuchtbauer have succeeded in showing that the molecule is capable of performing inter-nuclear vibrations without dissociatmg. The measurements described by them in the Zeitschrift fur Physik of Aug. 16 are an extension of the earlier work of Prof. W. E. Curtis, but had to be made with powerful prism spectrometers, as the bands which have now been studied are very feeble new bands have been classified, eleven being of an orthohelium type, and two of a parholium type plates have not been examined with a photometer, but it is certain that transitions in which there is no change in the motion of the component atoms along their line of centres are much more frequent than transitions in which this occurs.

ELEMENT 61.—The isolation of the new rare earth element of atomic number 61 is the subject of an article by Dr. Hopkins in the Journal of the Franklin Institute for July. The circumstances which resulted in the discovery are related, and a further attempt is made to establish the priority of the American chemists and their right to name the element illinium. The presence of a new element was suspected during the course of some work on the red and infra-red regions of the spectra of neodymium and samarium which was carried out by the United States Bureau of Standards with the co-operation of the University of Illinois. This was due to the presence of 130 faint lines of unknown origin common to both spectra. The Bureau of Standards published these results in January 1922, whereas Prof. Rolla, who claims priority for himself and insists that the element must be called florentium, only began his work about that time. However, neither Hopkins nor Rolla published definite proof of the isolation of the element until last year. A useful bibliography is to be found at the end of the paper.

DISPOSAL OF LIQUOR EFFLUENTS FROM CLAS-WORKS The Gas Effluents Research Committee, appointed by the Institution of Gas Engineers in June 1926, has recently issued its first report. The purpose of the Committee was to investigate the methods which might be adopted for minimising the production of gas liquor effluents or for rendering such effluents suitable for running into town sewers or into rivers The report contains a memorandum on the disposal of liquor effluents from gas-works, which forms a summary of existing knowledge of the problem and the contributions which have so far been made towards its solution A list of important references is appended. A number of experiments of preliminary character have been carried out, and a short summary of the results is given. The disposal of effluents which result from the production of aminonia compounds is one of the most difficult parts of the whole problem. The constituents of the spent liquor include many which absorb oxygen and would unduly retard self-purification if admitted to streams and merease the difficulties of sewage purification if admitted to sewers in sufficiently large quantities. At the present time, however, the only satisfactory method of disposal appears to be the admixture of the spent gas liquor with sewage. It is necessary to provide means for adjusting the rate of admission in order to avoid large changes in the composition of the mixed sewage. In the meantime investigations are in progress with the view of reducing the volume and improving the composition of spent gas liquor resulting from gas-works practice.

STRESSES IN LARGE TURBO-GENERATORS. The SIZE of the turbines used by electrical engineers to drivetheir generators is steadily mereasing. In designing large turbo-generators which run at 3000 revolutions per minute, it is necessary to calculate the enormous centrifugal forces and the resulting strains to which the rotating parts are subjected. During recent years, due to their high speeds, there have been a few explosions of the rotating parts which have caused considerable damage. The question of safety therefore is one of the chief considerations. In the July and August bulletins of the Oerlikon Co. of Zurich, an interesting description is given of the precautions which are taken and the tests which are made to ensure safety. A very large factor of safety is allowed for in the design. Instead of having only an overspeed test in an explosion proof chamber, the Company subjects the completed machine to a series of tests. For example, a 3000 r.p.m. rotor is first run at 2500 r.p m. A special gauge then measures, with an almost incredible accuracy, after the temperatures have been equalised, whether there has been any permanent expansion. Tests are then made at 2900, 3200, 3400, and 3750 r.p.m., measurements being made after each If permanent expansion exceeding the permissible limits occurs, the rotor is rejected. Many further tests are made before the rotor is regarded as The question of the stresses during an accidental short-circuit' of the generator has also to be considered. A 30,000 kilowatt turbo-generator requires about 1000 cubic feet of air per second for cooling purposes. Ordinary air contains about 8 milligrams of dust per cubic yard. Hence even when good air filters are used, large quantities of dust collect in blind corners and the fans get elogged. To prevent this the closed circuit method is adopted in the Oerlikon machines. The same air continually flows through the generators, the ducts forming a closed circuit.

# An International Congress of Soil Science.

NTERNATIONAL meetings of scientific workers on soils have been held at intervals since 1909, when a small group met at Budapest. Eventually the International Society of Soil Science was formally constinational society of Soil Science was formally consti-tuted at Rome in May 1924. The new body held its first triennial Congress at Washington, D.C., on June 13-22, 1927, under the presidency of Dr. J. & Lipman, of Rutgers University, New Jersey. About four hundred delegates were present. Very extensive preparations were made by the American Organising Committee on which Dr. Shutt, Dominion chemist, and other Canadian representatives served Schreiner and Dr McCall, of the United States Bureau of Soils, were chairman and secretary respectively of the executive committee Thanks to the efforts of Dr Lipman, no less than 75,000 dollars was obtained in donations from various sources towards the cost of the Congress, and the subsequent tour of North America Some thirty nations accepted the invitation of the United States Government to send official delegates The largest unit—more than twenty delegates—came from Soviet Russia, Germany sent ten, and Great Britain seven Most of the countries within the British Empire were also represented.

President Coolidge honoured the Congress by attending the first session and delivering the opening address, in which he paid a tribute to European work on soils, and briefly traced the development of Federal expenditure on agricultural research from the modest initial grant of 1000 dollars in 1839 to the present day

For convenience in administration the Society is organised in national sections, but for its scientific activities is divided into the following ('ominissions, or Sections:

(1) Physics

(2) Chemistry

(3) Biology and biochemistry.

(4) Fertility.

(5) Classification, nomenclature, and mapping of

(6) Rural engineering and drainage.

These sections met both separately and jointly. Their work was much facilitated, first by the issue, on the opening day, of full abstracts in English, French, and German of all papers presented; and secondly, by the arrangement whereby the sections met independently at least once in the interval between the triennial conferences of the Society. Thus the Physics Commission met at Rothamsted in October 1926 to discuss the results of co-operative work on different methods of mechanical analysis of soil, airanged at the Rome meeting in 1924, and the Chemistry Section met at Groningen, Holland, in April 1926, to discuss soil acidity and methods of measurement. Difficult and doubtful points had therefore been fully examined before the Washington meeting, and one of the important tasks—securing uniformity in routine methods of analysis in the different countries-was appreciably lightened.

From the general body of papers presented a few main subjects may be selected for brief comment. Various forms of apparatus for mechanical analysis of soil continue to claim much attention, especially those types yielding data less affected by the serious errors, first noted by Coutts and Crowther at Rothamsted, that are inherent in the method of continuous weighing of the sediment Further, a clearer distinction is now being drawn between this form of mechanical analysis, that aims at giving a particle size distribution curve for the soil, of use in research work, and the more usual type of routine analysis, that divides the soil into a few groups of particles,

employed in the qualitative association of mechanical composition of soils with their field behaviour question whether this relationship can be made more definite by supplementing the mechanical analysis figures with other physical determinations, was examined from several viewpoints and was considered sufficiently interesting to be selected for the next co-operative investigation of the Physics Section.

The Chemistry Section was largely concerned with soil acidity and base exchange phenomena, and the newer physical-chemical methods of investigating the absorbing complex Prof Wiegner, of Zurich, made a notable contribution to this subject. Prof Bradfield, of Missouri, discussed the use of electro-dialysis in physico-chemical investigations of soils, a method that promises to be of great assistance in research work

The Soil Biology and Biochemistry meetings were exceptionally well organised in a series of symposia, which included (a) direct and cultural methods of soil microbiology: Winogradsky's direct counting method received much attention in this section; (b) the soil population; (c) nitrogen fixation in the soil: in the course of the prominent contribution made by Japanese workers to this section, the new technique of serum-reaction for the classification of Azotobacter was discussed by Prof. Ago and Prof. Yoshida; (d) transformation of organic matter in the soil: this section was perhaps of the most general interest, particularly the question whether organic matter originates from lignin or cellulose, which was discussed by Dr. Waksman of New Jersey, and Mr. H. J. Page of Rothamsted

In the Soil Fertility Section, additional examples of exceptional and abnormal soils were recorded, and the well-known work of the California Station on the growth of plants in culture solution and soil solutions

was further developed.

The discussion on classification, nomenclature, and mapping of soils aroused great interest, especially in view of the presence of Prof. K. Glinka, of Leningrad, the acknowledged leader in this field. The outstanding contribution to soil science in recent years is undoubtedly that of the Russian workers in recognising the predominant influence of climatic environment on soil formation, and the demonstration of the different types of soil by means of soil profile examinations. Up to the time of the Rome meeting, these studies had been confined largely to eastern Europe, but the papers presented at Washington were evidence of the advances that have been made in nearly every country in the past three years The sub-committees dealing with the soil map of Europe and of the Americas were able to report considerable progress.

Irrigation, drainage, and soil erosion problems occupied much of the attention of the sixth section, but time was reserved for a meeting with the Physics Section to discuss physical properties of soil and methods of measurement, including the dynamometer measurements of soil resistance made in the course of the Rothamsted work on the physics of soil cultivation, that have disclosed an unexpected degree of hetero-

geneity in apparently uniform soil.

During the Congress a number of addresses were given at general meetings by prominent representa-tives. Dr. Woods dealt with the origin and objects of the United States Bureau of Soils, and Dr. Baker with the trend of land utilisation in the United States; the present status of soil biology was discussed by Sir John Russell, Prof Lemmerman of Berlin, and Prof. 'Sigmond of Budapest, dealt respectively with soil acidity determination, and the chemical characteristics of soil teaching. The Russian delegates gave an account of soil work in their country in two sessions specially reserved for this purpose. This arrangement was much appreciated by the Congress, as it gave an opportunity for members to hear something of the extensive Russian work on soil science that, owing to its publication in Russian journals, has not hitherto been generally known

The American committee also staged a very successful exhibition, in charge of Dr. Weir and Mr. Goll, of the United States Department of Agriculture, arranged

in the following divisions

(a) Representative soil types of the world, showing characteristic soil profiles (in monoliths)

(b) Soil maps

(c) Methods and apparatus for physical and chemical work on soils.

(d) Soil fauna and flora, together with biochemical and biological apparatus

(e) A complete collection of United States soil science literature.

The exhibition was by far the most complete one yet brought together, and its interest was enhanced by the inclusion of much of the apparatus and initerial discussed at the meetings of the Congress. It is the intention of the Committee to retain the monoliths of representative soil types as the basis of a permanent collection of the soils of the world.

At the conclusion of the Congress, the delegates joined a special train for a thirty-days' tour of the most important agricultural regions and soil belts of North America. Foreign delegates were the guests of the American Organising Committee during this tour. The route selected ran through the cotton belt, across

the southern portion of the Prairie and the Great Plain to the irrigated area in Utah, and thence across the desert to the irrigated region in South California. The return journey was made through California, Oregon, and Washington to Vancouver, and thence by the Canadian National Railway through Alberta and Saskatchewan to Winnipeg The tour then re-entered the United States, traversing the north and eastern sections of the Pranie before returning from Chicago to Washington, via Indiana, Ohio, and West Virginia. Many stops were made en route for the inspection of profiles typical of the local soils. This portion of the programme was arranged by Dr. Marbut, Chief of the United States Soil Survey, and his explanations of the various teatures in which some of the American soil types differed from the European soils on which climatic classification was initially based were of extreme value to European workers. Excursions were arranged at numerous points to see experimental stations, the local agriculture and objects of general interest.

A striking feature of these numerous trips was the generosity of organisations such as chambers of commerce, that arranged motor-cars for transportation, and provided meals for the whole party. It was evident, not only from the speeches of welcome at local centres, but also from informal talks with farmers and others, that the greatest interest was shown in the aim and objects of the Society; the bulk of this can be directly traced to the general appreciation of the work of the United States Federal and State agricultural services, and the consequent recognition by both the rural and urban population of the fundamental importance to the country of a vigorous agricultural life.

B. A. Keen

## A New Journal of Forestry.

SOME articles of considerable importance and interest appear in the first number of the new journal, Forestry. The number opens with an article on "British Forestry," by Mr. R. L. Robinson, a Forestry Commissioner. Much of this has appeared m the last report of the Forestry Commission, which has been already discussed in NATURE. It is rather of the nature of propaganda for the public than a technical treatise, for all British foresters will be acquainted with the position the writer depicts. Mr. H. M. Steven, the editor, follows with a lengthy paper on the "Silviculture of Coniters in Great Britain." This, and a companion article on the "Silviculture of Hardwoods in Great Britain," by Mr. W. II. Guillebaud, are of high intrinsic value. In these papers the past history of the principal tree species of Great Britain to the present day are traced, the methods by which they have been grown, and the ills which have so generally resulted in latter times from these methods. The historical data which Mr Steven gives on the subject of the Scots pine and the European larch, amongst other species, and Mr. Guillebaud's remarks on the oak and beech high forest, are well worthy of careful attention. If a word of caution is required, it may be confined to a necessary recognition that research and experiments based solely on the work of the past ten years should not be awarded, in the case of forestry, too great a prominence; for definite data will only be attainable at the end of a rotation, and in some cases possibly not even then.

The succeeding two articles on the "Utilisation of Soft Woods in Great Britain," by Mr. John T. Smith, chiefly dealing with Scotland, and the "Marketing

\*\* \*I Forestry The Journal of the Society of Foresters of Great Britain, vol. 1, No. 1 (1927), 7s. 6d

of British Hardwoods," by Mr. J. H. Newnham (Acorn), deal with the commercial aspects of forestry. There is little new in the articles, but the treatment of their subjects by the writers is not without interest to the professional forester, and some of the problems pointed out will need and are receiving eareful attention. Nor do the remedies all fall within the scope of the forestor. If the landowner of the future wishes to realise any return from the portion of his estate maintained under woodlands, he will have to adopt very different and drastic methods. The surest and the best will be to imitate some of his brother proprietors of land in France and learn how to manage his woods on sylvicultural lines himself. Unless the land tenure systems of Great Britain undergo a radical change, the country will not be able to depend, or afford to depend, solely on the efforts of the Forestry Commission for its tumber requirements. In no country in Europe are the forests in sole State ownership In the view of some experts the encouragement of the private owner to introduce a correct administration into his woodlands should form one of the chief objects of the Commission.

Major F. M. Oliphant deals with the manguration of the new "Forest Products Research in Great Britam," and describes the various sections of the work to be undertaken; whilst Mr W. Dallimore considers, in the lighter vein, the aesthetic side of afforestation, voicing opinions which have received attention in the press on the subject of the ugly uniformity of "huge blocks of pines... the trees spaced with mathematical accuracy and only relieved by other blocks of another kind of dismal uninteresting tree." The writer's suggestions merit considera-

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tion, especially the hope that all England's hedgerow trees and clumps and so forth are not doomed to

disappear.

Omitting several other technical articles, reference may be made to four papers from a foreign source. These are: "A General Review of Post-War Forestry ın Central Europe," by Dr. Ing. Franz Heske; "Some Recent Forest Research in Norway," by Erling Eide; "Recent Forest Literature in Denmark," by Carl Mar Møller; and "Forest Research in Finland," by Lauri Ilvessalo. Space will not permit a consideration of these papers, but the first calls for a brief remark. "The War and its consequences," says Dr. Fianz Heske, "have changed Central Europe in many important points Forestry being a welldeveloped and most essential part of the economic life in the respective countries, naturally could not escape the great transformations which have taken place" The writer deals with the changed conditions in Germany and the old Austrian monarchy. Immediately after the War, it appeared that forest policy and political conditions were the two items which required the most urgent revision however, says the writer, the problems of reform in sylviculture and management came more and more to the front, and the question of increasing the productivity of forestry became dominant He contends that these two directions of evolution can be clearly distinguished in the German countries, whereas in others, eq Czecho-Slovakia, political reforms have so far remained the chief interest. In this extremely interesting paper the author depicts the pre-War conditions of his subject and then deals with the post-War ones, as at present envisaged. The article is not, however, complete It is "To be continued" Since at present the journal is only to appear once a year, it is a pity that the whole could not have been included.

Reviews of some seven books are dealt with This is the weakest section of the journal. A far larger series of important forest publications could have found a place within the space allotted it some of the reviews included had been drastically cut down. If the high efficiency with which Forestry has been started can be maintained, all foresters in Great Britain should welcome and value such a professional journal.

# The Danish Lobster Fishery.

MR. ERIK M. POULSEN has published an interesting survey of the Danish lobster fishery compared with that of Norway, Sweden, and other countries ("Om Hummeren og Hummerfiskeriet i de Danske Farvande" Skrifter udgivne af Kommissionen for Danmarks Fiskeri—og Havundersøgelser No. 10 Copenhagen, 1927). Lobsters in the Danish seas are found along the coast from a depth of a few metres to about 40 metres, on a stony or gravelly bottom They are commonest on a stony bottom such as is found in the Northern Kattegat and Jammerbugton. Below a depth of about 40 metres they rarely occur, being replaced in the deeper waters down to about 300 metres by the Norway lobster (Nephrops norvegicus). The scarcity of newly hatched young in the upper water layers is remarkable, the author attributing this fact to the probable natural habitat being near the bottom even in the free-swimming stages, and after the third moult it apparently lives actually on the bottom.

Lobsters from the Danish Skaggerak coast are not merely larger than those from the Kattegat, but they are also distinctly larger than those from the Norwegian and Swedish Skaggerak coast as well as from the south-west coast of Norway. The reason for this attributed to the difference of salimity and temperature, a high salimity and high temperature being

agreeable to the lobster, a low salmity setting a limit to its distribution

Marking experiments by the method used by Appelhof in Norway and Tryboin in Sweden were undertaken, small triangular pieces being cut away from the edge of the telson and tail fin which were easily recognisable. In this way even if the skin be cast the cuts are still visible Out of one lot of 200 lobsters set free, only one made a long journey, nearly ten sea-miles; the others only went about one to three sea-miles. In a different lot a few journeyed ten to fifteen sea-miles. They are inclined to pass the summer in shallow water and the winter in deeper water, and this applies not only to the breeding females but also to others of a certain size which seem to need different conditions in the summer The abundance of food in the shallower waters near the coast seems obviously an advantage for the newly hatched The author does not mention the hatching and rearing experiments made at Port Erin, Isle of Man, which prove conclusively that the newly hatched lobsters, and also those in the first tew stages, feed on small planktonic organisms, especially copepods.

Interesting notes are given on the methods of catching lobsters, traps being chiefly used, the bait being flat fishes (plaice and dabs), small haddock, and fishing-frogs.

# University and Educational Intelligence.

OXFORD—The new Rockefeller School of Biochemistry will be opened by the Lord Chancellor, Viscount Cave, on Friday, Oct. 21, at 3 30 Pm.

THE City and Guilds of London Institute has received from the Corporation and City companies since its foundation forty-seven years ago contributions amounting to £1,156,094. Its report for the year 1926 deals with the affairs of the City and Guilds (Engineering) College, the Finsbury Technical College (finally closed in July 1926), the South London Technical Art School and the Department of Tech-The first-mentioned college was in 1907 merged in the Imperial College of Science and Technology, but the Institute continues to contribute to the cost of its maintenance. Of the two thousand degrees in engineering awarded by the University of London since 1903, nearly half have been won by students of this College. In 1926, for the first time, the degree was awarded on the College examinations, and the results show, says the Dean, that there is very little difference between the standards under the new and the old system, and he concludes that "whatever system of examination be applied to young men, provided they are properly trained, the result is substantially the same "The Department of Technology examined 13,985 candidates for its certificates, including 1788 at places outside the British Isles. The report suggests a doubt as to whether the movement in tayour of demanding a more definite knowledge of elementary science (especially physics and chemistry) as forming the ground work of the main technical subject, has not been pressed too far.

That the teacher should never cease to be a student is, perhaps, a platitude. In few places, however, are there such opportunities for the teacher-student as are available in London. Lectures and classes for teachers, specially arranged by the London County Council, make it easy not only to follow up special subjects, but also to obtain a view of the wider background which gives significance to those subjects. Facilities are provided at fees which average less than 1s. per lecture for any one engaged in teaching in London, Kent, or Middlesex (other teachers are admitted at fees 50 per cent. higher),

and are designed to bring London teachers into touch with the latest developments in educational methods and to enable them to hear leading authorities on current questions of importance The recently published Handbook to the Lectures for 1927-28 contains details of arrangements made to cover a vast number of subjects. In the science section are courses of lectures and lecture demonstrations on the application of physics to everyday life, light, with special reference to artificial light and its measurement; the Science Museum (intended to give a fuller acquaintance with the contents of certain of the Museum's engineering collections), science for elementary schools and for guls' schools, nature study, with special reference to the open spaces in and near London; nature study in infants' schools By the courtesy of certain scientific societies, provision is also made for the disposal by the L C C. of a number of tickets of admission to their ordinary meetings Domestic and health subjects include a single lecture on sunlight and health, and ten lectures on dietaries in relation to health. The geography section includes a course dealing with the relation between geography and agriculture. Experimental psychology and its bearing on education is to occupy five lectures Particularly important is a course on modern thought and education, the purpose of which will be to consider the background of instructive ideas which controls the activities of this generation and is expressed in the contemporary attitude towards education. In most cases the Handbook gives, in connexion with the courses, lists of books recommended for study.

EDUCATIONAL Boards and Foundations in the Umted States are described in Bulletin, 1927, No 10 of the Bureau of Education. The General Education Board has, since its foundation in 1902, appropriated 137 million dollars for the promotion of education in the United States. For the year 1925-26 appropriations amounted to 15 million dollars, half from principal and half from income. The Rocketeller Foundation spent 9 million dollars on health projects and medical education, including expenditure through its International Health Board and China Medical Board. The Laura Spelman Rockefeller Memorial appropriated for educational, charitable, and scientific purposes nearly 8 million dollars, including nearly one million dollars for the promotion of child study and parental education. The Carnegie Corporation of New York made grants amounting to 6 million dollars, of which more than 41 million dollars went to library service, 600,000 dollars to activities in the fine arts, and 300,000 dollars to the newly formed move-ment for adult education. The Carnegie Foundation for the Advancement of Teaching disposed of an meome of  $1\frac{1}{3}$  million dollars, devoted mainly to retiring allowances and pensions. Other important foundations described are the John F. Slater Fund for teacher training and other schools in the Southern States; the Jeanes Fund for the improvement of negro rural schools; the Phelps-Stokes Fund for improving New York slums and the education of negroes, Indians, and needy whites; the American Field Service Fellowships for French Universities; the Belgian Fondation Universitaire; the Julius Rosenwald Fund for charitable, scientific, educational, and religious purposes; the Baron de Hirsch Fund for aiding Jewish immigrants; the Kahn Foundation for foreign travel of teachers; the Commonwealth Fund for child welfare, rural hospitals, and education; and the Engineering Economics Foundation. The Commonwealth Fund maintains 23 fellowships, amounting to 125,000 dollars, for graduates of British universities for two years' study in American universities. Three are earmarked for British overseas dominions students.

# Calendar of Discovery and Invention.

September II, 1822—Copernicus asserted the daily rotation of the earth on its axis, and showed that it accounted for the apparent diurnal revolution of the stars. He also showed that most of the known motions of the planets could be explained by assuming them to revolve round the sun, with the earth as one of them. The teaching of the Copernican theory was torbidden by the Church in 1615—On Sept. 11, 1822, the Pope repealed this decree, and permitted the Copernican views to be taught—nearly three hundred years after they were first published.

September 12, 1891. A scheme for the electrical transmission of power on the three-phase system from Lauffen to Frankfurt a M in Germany was prepared by Michael von Dohvo-Dobrowolsky; the system was erected and put into operation on Sept. 12, 1891. The distance covered was 175 km, three copper wires of 4 mm diameter being used. The alternator voltage was 55, and this was raised by transformers to 8500. The efficiency of transmission was 74 per cent.

September 13, 1850. After years of labour, the engineers lowered the last of the tubes of the Britannia Bridge, over the Menai Straits, to its permanent resting-place on Sept 13, 1850. The bridge has two spans of 460 ft, and two of 230 ft., at 104 ft. above high water. The official return of the cost was £601,865.

September 14, 1899 — The Times of this date reports that "for some weeks past experiments of great interest in wireless telephony, as distinguished from Signor Marconi's wireless telegraphy, have been carried on by Sir William Precee near Carnarvon. Sir William has succeeded, without any intermediary other than the ether, in transmitting the sound of a series of taps. . . . They were distinctly heard at the receiving station by placing the newly invented ethereal telephone to the ear. . . . So far, it is stated, the system yields much more rapid results than Marconi's, although the sounds are not quite so distinct as desirable."

September 15, 1830. A number of routes for a railway between Liverpool and Manchester had been proposed and surveyed before a final scheme was authorised in 1826. George Stevenson was the engineer, and the line, which was 31 miles in length, was opened for public traffic on Sept. 15, 1830. In 1845 it was amalgamated with the Grand Junction Railway, and in the following year these became part of the London and North-Western system. The gauge was 4 ft. 8 5 m., and the ruling gradient 1 in 89. There were 63 bridges on the line

September 16, 1911.—Edward Whymper is most popularly associated with the tragic first ascent of the Matterhorn in 1865. He was the pioneer climber of many other peaks of the Alps, the Andes, and the Rockies. More than a successful mountaineer, he was a keen observer of geological phenomena, a student of glaciers, a first-rate collector, and a good woodengraver. He died suddenly at Chamonix on Sept. 16, 1911. A plaque to his memory was unveiled at Zermatt in 1925.

September 17, 1607.— Thomas Harriott first saw the comet of 1607 (Halley's) from Ilfracombe on Sept. 17. He made observations upon it with a 'cross-staff,' giving the distances of the nucleus from the various stars. Harriott had been to Virginia as a surveyor with Sir Richard Grenville's expedition in 1585. He virtually gave to algebra its modern form, and applied the telescope to celestial purposes almost simultaneously with Galileo. With its help he studied the moon, "the new-found planets about Jupiter," and sunspots.

W. C.

### Societies and Academies.

#### PARIS.

Academy of Sciences, Aug. 1.—A. Lacroix The composition and structure of the meteoric iron of Tamentit. The oxidation of meteoric iron at a high temperature. Analyses gave iron 91 per cent., nickel 8 per cent, cobalt 0.38 per cent, with some manganese, phosphorus, sulphur, carbon, and silicon The meteorite weighed 510 kilograms, and a piece was cut off by means of the oxyacetylene blowpipe. Analyses of the magnetic oxide produced showed it to be free from nickel, and the metal fragments taken from the scoria showed a concentration of the nickel. bearing of this on the composition of meteorites containing silicates is discussed.—F. E. Fournier Thesistance of water to the translation of hulls-Gabriel Bertrand and Hirosi Nakamura: The physiological importance of nickel and cobalt. In an earlier communication (Bertrand and Machebœuf) it has been shown that traces of nickel and cobalt are normal constituents of man and of animals. Experiments on mice suggest that these two metals have a direct action in nutrition .- d'Arsonval: The heating of the tissues by high frequency currents The thermal ammeter is generally employed to measure the strength of the currents used; but it is not a trustworthy guide when used as a measure of the heating of the tissue under treatment.—Léon Guillet, de Fleury, and Sensaud de Lavaud The aluminium-silicon alloy known as 'alpax': its applications Mechanical properties of the alloy cast at 575° and 775° C, after addition of sodium. It can be used in the construction of motor-car chassis.—G. Friedel: Forms assumed by myeline in contact with water.—Amé
Pictet and H Vogel The synthesis of lactose. Equal weights of  $\beta$ -galactose and  $\beta$ -glucose, with a little zinc chloride, are heated under reduced pressure to 175° C. That lactose was obtained was proved by its melting point, solubility, and rotation. The osazone, nitrate, and acetate were prepared.—Charles Nicolle, Charles Anderson, and Jacques Colas-Belcour: A new pathogenic spirochæte (Sp. Normandi) transmitted by an Ornithodorus (Orn Normandi).—Krawtchouk The poles of analytical functions.—C. Irañez de Irero: A submanne link between Spain and Morocco, by means of an intercontinental tunnel. A tunnel across the narrowest part of the Straits would be impossible, as there are depths of more than 900 metres. A possible line is sketched out which would have a length of 48 2 kilometres, of which 32 kilometres would be under the sea.—F. Gonseth and G. Juvet: The equations of electromagnetism —James Basset: An apparatus for carrying out physical or chemical experiments at varying temperatures and under pressures of 15,000 kilograms per square centimetre. The description is accompanied with photograph and sectional drawing of the apparatus.—B. Cabrera The theory of paramagnetism.—Armand de Gramont. Monostatic telemetry during twilight -R. de Mallemann and P. Gabiano: The circular dichroism of the alkaline cuprotartrates.—Lucien Mallet: The luminescence phenomena in the course of oxidising reactions m aqueous solutions. During the oxidation with alkaline hypochlorite of various organic substances (albumen, methylene blue, eosin, quinine, etc.) light is produced. The intensity is increased when the temperature is raised.—Eugène Delauney: A new method of quantitative analysis applicable to a mixture of rare earths. The method is based on the measurement of the thickness of an absorption band, \_as shown in a small Hilger spectrograph. Various examples of the use of the method are given.—W.

Ipatieff and J. Andrewski The precipitation of ridum and its solutions by hydrogen under pressure. At temperatures of 100° and 103° C the proportion of iridium reduced by hydrogen has been studied for pressures between 1 and 10 atmospheres The reduction increases with the dilution, with the pressure of the hydrogen and with the time of exposure. The general results are very similar to those previously obtained with platinum.—Dedebant: The field of instantaneous displacement of isobars.—Mlle. M. Gauthier · The French larvæ of Ephemerids referred to the genus Iron -F. Mercier and Raymond-Hamet: The vaso-constrictive action of hydrastine —Mme. L. Random and Mlle A. Michaux The variations in the proportions of iron in the liver, the spleen, and the blood, under the influence of feeding in the complete absence of the antiscorbutic vitamin.—Raoul M. May: Microchemical studies on the nervous system. The proportion of sulphur and phosphorus in the cerebral hemispheres of the guinea-pig.— Charles Lebailly · The preventive and specific vaccination of dogs against distemper.

Aug 8.—The president announced the death of Emile Schwoerer, correspondant for the section of mechanics. -Charles Nicolle and Charles Anderson: The transmission of the spirochæte of the shrew mouse by Ornithodorus moubata and the mechanism of the transmission of recurrent spirochetes by ticks.—S. Finikoff: Stratifiable congruences —Pierre Dive: The most general internal movements of a heterogeneous fluid mass in rotation round an axis.—Louis de Broglie The rôle of the continuous  $\psi$  waves in undulatory mechanics Maurice Lambrey: The absorption and emission spectrum of nitric oxide in the ultra-violet. Nitric oxide has been considered as completely transparent, but has now been found to have absorption bands in the ultra-violet. The same lines were found in the spectrum given by the gas in discharge without electrodes. Carbon monoxide was also found to give a fine absorption band in the same region.—René Dubrisay and Jean Bravard: The influence of absorbent materials on chemical equilibria in solution. In the reaction between ammonium chloride and calcium carbonate in aqueous solution, the equilibrium is displaced by the addition of absorbent substances, such as kieselguhr, sand, precipitated silica, clay, and kaolin.—Emile André and Mile. Th. François: The study of oleilic alcohol and its derivatives. Preparation of oleicerine, elaidicerine, and stearolylic alcohol. -J. Dugué: Modifications of methods and of treatments resulting from the application of the theory of antioxygens. Discussion of the preparation of indiarubber from the point of view of the antioxygen theory.—R. Abrard, L. Joleaud, and Paul Lemoine: The conditions of the deposit of the Montian of Port-Marly (Seine-et-Oise).—E. Rothé, J. Lacoste, and Mlle Y. Dammann: Earthquakes in France in 1926. Fifteen well-characterised earthquakes were felt in France during 1926. The Pyrenees region and the Central Plateau were more stable than in preceding years; the most important phenomena affected Alsace and the Channel coasts.—Henri Humbert. A new Composite remarkable from the phylogenic point of view, *Tisserantia africana*.—A. Lebediantzef. The modifications of the solubility of the phosphoric acid and the biological properties of the soil observed in earth lying fallow and previously dried in the open air—A. Th. Schlæsing: Remarks on the preceding communication.—Edouard Chatton and Mme. M. Chatton: The conditions necessary for determining experimentally the conjugation of the Infusoria Glaucoma scintillans.—F. Viès and A. de Coulon: The experimental modifications of the receptivity

index of mice for grafts of tumours—George F Jaubert. The origin of the yellow colour of beeswax—Weinberg and J Barotte. Researches on antitoxic and antimicrobial sera.

#### SYDNEY

Royal Society of New South Wales, July 6 - J. W. Fielding · Observations on rodents and their parasites The author examined 222 rats collected alive at Townsville, N Queensland, for ectoparasites. them he found 536 fleas, of which 493 were Xenopsylla cheopis, 33 Ctenocephalus felis, 8 Ctenocephalus canis, 1 Pulex irritans, and 1 Ctenopsylla musculi Two were covered with an undetermined genus and species of mite Data as to leprosy in rats, and also the presence of Trypanosoma lewisi, Leptospera icterohæmorrhagica, Eimeria sp. and worms were given —The late Sydney Dodd · Swelled head in merino rams Although the almost invariably fatal condition known among sheepowners as 'swelled head' is generally regarded as affecting only young merino rams, it also occasionally affects older sheep. The condition has been ascribed from time to time to a number of different causes, including plant poisoning and streptococcic infection A bacillus has been found in the adematous fluid of the face, in the tissues of the affected muscles of the head and in the heart's blood during post-mortem examinations made immediately after death on typical cases. Experimental inoculation of pure cultures of this bacıllus into the leg of a sheep produced lesions similar to those met with in cases naturally The organism is anærobic and shows evidence of gas formation with dissociation of muscular tissue, but not particularly of a rancid nature -W. F. Blakely: Descriptions of nine new species of Eucalyptus Five of these belong to the Stringybark group, two to the Peppermint group, one is Ash, and one Bloodwood. Eight are indigenous to New South Wales, and one to the Northern Territory -- A. R. Penfold: The essential oil of Eucalyptus Bakeri This pendulous willow-like tree of 30 ft.-50 ft. in height has a range from northern New South Wales to central Queensland. The principal constituents of its oil are cineol (70-77 per cent.), cymene, the aromatic aldehydes (cuminal, phellandral, cryptal), phloracetophenone-dimethyl other and the esters (isobutyric, isovaleric, and formic) of cuminol and phollandrol. Australol (p-isopropyl phenol) d-a-pinene and Australol (p-isopropyl phenol) d-a-pinene and sesquiterpene alcohol were also present in small quantities.

#### WASHINGTON, DC.

National Academy of Sciences (*Proc.*, Vol. 13, No. 6, June).—H. Walter Leavitt and John W. Gowen Mineralogical content of Maine sands in relation to mortar strength. The percentage of granitic material in the sand plotted against the tensile strength after 7 days and 28 days setting, shows that strength decreases with increase of granitic material; thus quartz sand is not the best for making strong concrete Increased strength goes with increased iron content and the latter with decreased granitic content, but there is also an independent effect of iron.—Dickinson W. Richards, Jr.: On the mechanics of blood flow, with special reference to the influence of change of posture. On changing from recumbancy to the standing posture, blood pressure increases and the volume of blood flow decreases in man. Applying Poisseuille's law of flow of a viscous liquid in a cylindrical tube, it is suggested that the changes are associated principally with arterial construction.—Francis G. Benedict and Cornelia Golay Benedict: The nature of the insensible perspiration. The subject

hes on the balance and breathes into a closed circuit respiratory apparatus also on the balance weight then measures the loss through the skin (chiefly water), and it averages 50 per cent. of the total loss The total msensible loss of a woman is 20 gm.-30 gm per hour, that of a man is nearer 40 gm per hour. Of this, about 45 per cent is water from the skin, about 45 per cent is water from the lungs, and 10 per cent. is the difference between oxygen mtake and carbon dioxide output The temperature of the environment and clothing make little difference The total insensible loss is a good index of the total metabolism. - A M Showalter · Hermaphroditism in a directous Hepatic Raoul M. May. Modifications of nerve centies due to the transplantation of the eye and olfactory organ in anuran embryos. The grafts develop synchronously with the corresponding organs of the host. There is at first. marked affinity between the optic neuroblasts and those of the central nervous system (neuroblastotropism). The pia mater is only penetrated with difficulty by axons from the grafts. Samuel F. Hildebrand and Charles Hatsel. On the growth, care, and behaviour of loggerhead turtles in captivity. The incubation period for the eggs appears to be-64 days, and the young remained at the surface of the water in the aquarium. Even when grown, they are sensitive to cold. Two specimens reared from eggs were kept for six years, their food being mainly fish, with occasional blue crabs and hard clams. Their weights when released were 55 lb. and 61 lb -William Albert Noyes: (1) Magnetic hydrogen atoms and non-magnetic molecules. Suppose that under the catalytic effect of a metal, the orbits of the electrons of loosely joined hydrogen atoms are made to take opposite directions: the electrons are held by their nuclei but fall closer because there are now tweenuclei instead of one. This might account for the dissipation of energy when the molecule for is. (2) The relation of the octet of electrons to consacton. Close approach of atoms, molecules, or ions in solution involves strong repulsion between the external shells of electrons, leading to elastic collisions in which the components maintain their independent existence after collision. Edison Pettit: Ultra-violet solar radiation. Two quartz cells, each consisting of a lens and plate, one silvered and the other gilded on the inner surfaces, are mounted at opposite ends of a diameter of a disc. The disc is carried by a spindle operated by an escapement so that an image of the sun formed by the silvered cell falls in turn on the junctions of a compensated thermocouple, after which the same procedure is carried out with the gilded cell. The galvanometer deflexions are recorded photographically and give the ratio of ultra-violet to green radiation every four minutes. The green radiation remains fairly constant, whereas the ultra-violet is zero for some time after sumrise and reaches a maximum at noon. The monthly mean of the ultraviolet radiation follows roughly the solar constant and the Mount Wilson daily sunspot numbers, but runs counter to the atmospheric ozone curve -B. P. Gerasmovič and W. J. Luyten. On the distance of the sun from the galactic plane. The mean elevation of the sun above the galactic plane defined by the Cepheid variables, the O, B, and c and ac stars is +33 parsecs, with a mean error of not more than 3 parsecs—Walter S. Adams and Alfred II. Joy: (1) The relationship of spectral type to period among variable stars. There is a practically linear correlation between spectral type and logarithm of period of light variation for the best known Copheids. Long period variables and the mean for short period cluster type. variables fall nearly on the Cepheid curve. (2) Highdispersion stellar spectra and some results of a study of  $\gamma$  Cygni. A spectrograph of 15 ft focal length and 6 m. aperture has been installed with the 100 m. reflector at Mount Wilson, the linear scale of the spectrographs obtained is about 2.9 ÅU to the millimetre at Hγ. Lines of rare earths have been identified in the spectra of γ Cygni and those of Ce<sup>+</sup> show a systematic displacement, possibly caused by relative upward motion of the gases where they originate -M S. Knebelman · Groups of collineations m a space of paths -P. Ehrenfest and P. S Epstein Remarks on the quantum theory of diffraction-Richard M. Badger Absolute intensities in the Absolute intensities in the hydrogen chloride rotation spectrum The probabilities of transition from the initial to the final state with absorption of radiation are calculated from integral absorption coefficients, but the experimental results are not in agreement with the predicted values. -R.B. Lindsay: Note on 'pendulum' orbits matomic models The 'pendulum' orbit involves the notion of an electron penetrating the nucleus This may be avoided by assuming a repulsive force in the neighbourhood of the nucleus Assuming this obeys an inverse cube law, reasonable values of the effective radius of the nucleus are obtained -Bergen Davis and Harris Purks Measurement of the Mo  $\check{K}$  doublet distances by means of the double X-ray spectrometer. One crystal is mounted as usual on the spectrometer table and a second crystal is carried on a rotating arm; radiation is reflected from the first to the second and thence to the ionisation chamber The angle through which the second crystal is turned is twice the difference between the angles for reflection of two The results are closely independent of horizontal slit width, so that it is possible to have sufficient intensity of radiation to permit accurate measurements—J. C Slater: The structure of the helium atom (1). A method is developed of obtaining an approximate solution to the problem of calculating the spectrum of helium from the wave equation of mechanics. It can also be applied to yield qualitative results with higher atoms and molecular structure.— Walter A. MacNair: The Zeeman effect of the hyperfine structure components of  $\lambda$  2537 of mercury. Each of the five lines found by Wood has a triplet Zeeman pattern.—Paul S. Epstein. The dielectric constant of atomic hydrogen in undulatory mechanics. For the excited states of the atom, in weak fields the orientation is arbitrary; in strong fields this is not so. Owing to the complete symmetry of the atom in the normal state, the question of orientation is here without meaning—Evelyn F Aylesworth. The discertic constant of atomic hydrogen from the point of view of Bohr's quantum theory. The calculations lead to results similar to those recorded in Epstein's paper above.—David L. Webster: Direct and indirect production of characteristic X-rays Indirect rays will be produced at depths in the target averaging more than the mean depth of rays producing the continuous spectrum. With a target of silver 25 microns thick plated with copper, the majority of the K-radiation is direct when the cathode rays are driven by a steady voltage of 35 kv., d.c. Other targets used were blocks of cadmium with one or two sheets of silver foil 6 microns thick and a block of graphite plated with silver 3 5 microns thick. With 50 kv., the ratio of the direct to the indirect rays was 2.36.— Carl Barus: Mucronate electrode with micrometer.— Carl Eckart: The reflection of electrons from crystals. Electron reflection differs from X-ray reflection in that a single plane of atoms reflects an appreciable fraction of the electrons and that the wave-length of the electron wave inside the crystal differs from its wave-length in free space.—Edward Uhler Condon.

(1) Coupling of electronic and nuclear motions in diatomic molecules (2) Wave mechanics and the normal state of the hydrogen molecule. A discussion based on the quantum theory of the binding of atoms mto molecules (valency forces) gives results in fair accord with experiment.—Gilbert N. Lewis A new equation for the distribution of radiant energy-C. F. Richter. The hydrogen atom with a spinning electron in wave mechanics. It is claimed that the fine structure of hydrogen-like spectra can be represented completely by the Schrodinger wave mechanics with the Uhlenbeck-Goudsmit spinning electron

# Official Publications Received.

The North of Scotland College of Agriculture Guide to Experiments and Demonstration Plots at Craibstone, 1927 Pp vii+56 (Aberdeen) Memors of the Department of Agriculture in India Botanical Series, Vol 14, No 4 Studies in Gujurat Cottonis Part iv Hybrids between Broach-deshi and Goghari Varieties of Gossypium herbaceum By Maganial L Patel and S J Patel Pp 131-176 (Calcutta Government of India Central Publication Branch ) 14 annas, 18 6d
Aeronautical Research Committee Reports and Memoranda No 1079 (E 24) Summary by the Secretary, Engine Sub-Committee, of a "Report on Anti-knock Investigations" By A Egerton and S F. Gates (I C E 561) Pp 13+13 plates (London H M Stationery Office) 9 9d net
Royal Commission on Agriculture in India Vol 1, Part 2 Evidence of Officers serving under the Government of India. Pp 1vix+378+18 plates (London H M Stationery Office) 6s 3d net
The Journal of the Institute of Metals No 1, 1927 Vol 37. Edited by G Shaw Scott Pp vi+880+75 plates (London The Institute of Metals) 3ts 6d net
Statist Settlements Annual Report on the Raifies Museum and Library for the Year 1926 By C Boden Kloss: Pp 14 (Simgapore) Western Australia Annual Progress Report of the Geological Survey for the Year 1926 Pp 20+7 plates (Perth Fied Wm Simpson)
Western Australia Annual Progress Report of the Geological Survey for the Year 1926 By C Boden Kloss: Pp 14 (Simgapore) Western Australia Geological Survey Bulletin No 84 The Field Geology and Broader Mining Features of the Leonora-Duketon District, including parts of the North Coolgardie, Mt Margaret and East Murchison Goldfields, and a Report on the Anaconda Goppe Mine and Neighbourhood By E de C Clarke Pp 64+1 plates Bulletin No. 80 The Geology and Mineral Resources of the Yalgoo Goldfield. By E de C Clarke Part 2 The Mining Centres of Rothesay and Gooding-now (Payne's Find). Pp 41+3 plates Bulletin No 90 The Geology of a portion of the East Coolgardie and North-East Coolgardie Goldfields, including the Mining Centres of Monger and St. Ives By E. de C Clarke Pp 14-6 p

Association for the Cultivation of Science ) 3 rupees, 4s
Uganda Protectorate Annual Report of the Geological Survey
Department for the Year ended 31st December 1926 Pp 43 (Enteblie
Government Printer) 3s.
Memoirs of the Department of Agriculture in India Chemical Series,
Vol. 9, No 3 Some Digestibility Trials on Indian Feeding Stuffs, II.
By Dr P. E Lander and Pandit Lal Chand Dharmani Pp 11+63-83
10 annas, 1s. Chemical Series, Vol 9, No 4. The Effect of Manuting a
Crop on the Vegetative and Reproductive Capacity of the Seed By B
Viswa Nath and M Suryanarayana With a Summary of the Results of
certain Animal Nutrition Experiments carried out by Lt-Col. R.
McCarrison Pp 11+85-124 14 annas, 1s of (Calcutta Government
of India Gentral Publication Branch)
The Hundred and Fifth Report of the Commissioners of Crown Lands,
in Obedience to the Acts 10 George IV (Cap. 50) and 2 William IV.
(Cap 1), being the Seventy Sixth Report under the Act of 14 and 15
Vict (Cap 42), dated 30th June 1927. Pp 38 (London H.M Stationery Office) 4s net
Aeronautical Research Committee Reports and Memoranda No 1978
(Ae 250) The Application of the Algebraic Formulae of R. and M. 1956
to Problems of Aircraft Performance By W G Junnings, N. E. Rowe
and I Bowen (D I Special Technical Questions, 195 and a — T 2375
and a) Pp. 11+11 plates 9d. net No. 1988 (Ae 257), Preliminary
Report on the Fitting of Slots and Flaps and Slot and Aileron Control to
a Bristol Fighter. By H. L. Stevens (A 2.b. Stability—Full Scale
Experiments — T 2420) Pp 3+2 plates 4d. net No. 1992 (Ae 271).
A Distant-Reading Instrument for the Measurement of Small Displacements By E. F. Relf and L. F. G. Summons (O 1 Accessories—
Instruments, 95—T. 2429) Pp 4+1 plate 4d. net. (London. H.M.
Stationery Office)
The British Research Association for the Movinement of Science,
August Slats—September 7th, 1927 Pp. 48+4 plates. (Leeds)
Report of the Progress of the Ordnance Survey for the Financial Year
1st April 1926 to 31st March 1927. Pp 9+5 plates. (London H.M.
Stationery Office

#### FOREIGN

Skogsforsoksanstaltens Exkurzionsledare 12 Geologie, Jordmån och, Vegetation inom Siljansfors Forsokspark i Dalarna By Karl Lundblad Pp 112+3 maps (Stockholm Centraltryckeriet)

Meddelanden från Statens Skogsforsoksanstalt Halite 23, 1926-27.

Pp 689+2 plates. (Stockholm Centraltryckeriet) 10 kr
Department of Commerce. Bureau of Standards Scientific Papers of the Bureau of Standards, No 553 Further Radiometric Measurements and Temperature Estimates of the Planet Mars, 1926. By W. W. Coblentz and C. O. Lampland. Pp 236-276. (Washington, D.C. Government Printing Office.) 15 cents
Journal of the College of Agriculture Hokkaido Imperial University, Sapporo, Japan Vol 19, Part 1. New Species and Subspecies of Moths from the Japanese Empire By Prof Di. S Matsumura. Pp 96+5 plates Vol 20, Part 2 Die Hydrolyse des Leders, von Prof. Dr G Grasser, Emfiluss der Deduktions-methoden auf die Aussfockungszall, von Prof. Dr G Grasser und Dr S Sawayama. Pp 49-78 (Sapporo)

The Science Reports of the Tohohu Imperial University, Sendar, Japan Second Series (Geology), Vol 10, No 3 On Brom eagure Matsumoto and its Ancestry, by Hikoshishiro Matsumoto. On a new Fossil Race of the Asiatic Elephant in Japan, by Hikoshishiro Matsumoto Pp 1-02+4 plates (Tokyo and Sendar Maiuzen Co Ltd.)

Muistry of Agriculture. Evypt. Technical and Scientific Service.

Fossil Race of the Asiatic Elephant in Japan, by Hillonishiff Matsumoto Pp 51-62+4 plates (Tokyo and Sendai Maillean Co Ltd)

Ministry of Agriculture, Egypt Technical and Scientific Service. Bulletin No 71 Investigations on Raw Cotton, Deterioration of Cotton during Damp Storage By Alan Chamley Burns. Pp 107-92+13 plates (Cairo Government Publications Office) 10 P T

Koninklijk Nederlandsch Meteorologisch Instituut No 113 Rappord de la Reunion de la Cominission Internationale de Meteorologie Maritime a Zurich 14-17 Septembre 1926 Pp 21-41 planche ('s-Gravenhage Algemeene Landsdrukkerij) 0.30 ft.

Department of the Interior Bureau of Education. Bulletin, 1927, No. 14 Physical Education in American Colleges and Universities By Marie M Ready. Pp 10+51. (Washington, D.C. Government Printing Office) 10 cents.

Bulletin geodésique: Organe de la Section de Geodesie de l'Union Geodesique et Géophysique Internationale. Année 1925, No 8, Octobrenovembre-decembre 1925 Pp 597-722. Année 1926, No 10, Avril-mailuin 1926 Pp. 81-154. Année 1926, No 11, Juillet-août-septembre 1926 Pp. 155-186. (Toulouse Edouard Privat, Paris: J. Hermann)

The Metabolism of the Fasting Steer. By Francis G Benedict and Prof Ernest G Ritzman (Publication No 377) Pp viii+246. (Washington, D.C. Carnegie Institution)

Department of the Interior U.S. Geological Survey. Water-Supply Paper 540 Surface Water Supply of the United States, 1922. Part 9 Colorado River Basin. Pp v-175-2 plates 25 cents. Water-Supply Paper 551, Suiface Water Supply of the United States, 1922. Part 11. Pacific Slope Basins in California Pp viii+405+2 plates 50 cents. Water-Supply Paper 555. Suiface Water Supply of Hawaii, July 1, 1922, to June 30, 1923. Pp. iv-178. 25 cents (Washington, D.C. Government Printing Office)

Department of the Interior U.S. Geological Survey. Builletin 789; to June 30, 1923. Pp. iv-178. 25 cents. (Washington, D.C. Government Printing Office)

Department of the Opper Matanuska Vailey, Alaska. By Stephon R. Capps With a Section on the Igneous Rocks, by

Office.)

+92+16 plates 30 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 71, Art. 13
A Revision of the Cottoud Fishes of the Genus Artediellus. By Peter Schmidt (No. 2085.) Pp. 10 (Washington, D.C.: Government Printing Office.)

Field Museum of Natural History. Anthropology Leallet No. 22: Insect-Musicians and Cricket Champions of China. By Berthold Laufer. Pp. 27+12 plates (Chicago, III) 50 cents

Publikationer fra det Danske Meteoologiske Institut Communications magnetiques No. 1. Sur Perreur moyenne des moyennes mensuelles des elements magnetiques observées à l'Observatoire de Rude Skov, par D la Cour; No. 2 Direct Determination of Scale Values at the Magnetic Observatory at Godhavn, by Johannes Olsen. Pp. 33+7. (Kobenhavn: G. E. C. Gad.)

Institut de Géophysique et de Météorologie de l'Université de Liwow. Communications, Vol. 2, Nos 19 à 30, des résultats des recherches de Henryk Arctowski et de ses collaborateurs MM. Henryk Orkisz, Edward Stenz, Stamslaw Zych, Wincentry Przepiórski et Jan Moniak, faites à la Societe des Naturalistes Polonias et publiées dan la revue Kosmos, Vols. 51 et 52 Pp. VIII-167+234. (Liwow.)

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Société des Nations: League of Nations. Bulletins de l'Institut International de Coopération Intellectuelle: Bulletin des Relations scientifiques. 2me année, No. 3, Août Pp. 309-401. (Paris: Les Presses universitaires de France) 8 francs.

#### CATALOGUE.

Instrumentos de precisión Cambridge para aplicaciones industriales. Catalogo No. 9078 Pp. 40. (London: Cambridge Instrument Co., Ltd.)

# Diary of Societies.

# SATURDAY, SEPTEMBER 10

Institution of Municipal and County Engineers (Eastern District Meeting) (at Town Hall, Lowestoft), at 11 a.m.

#### TUESDAY, SEPTEMBER 13

Institute of Marine Engineers (at 85 The Minories, E.1), at 6.30.— Eng.-Capt. W. Onyon; Presidential Address

No. 3019, Vol. 1201

#### CONGRESSES.

#### SEPTEMBER 11-17.

International Congress of Physics in Commemoration of the Centenary of Volta (at Como)

#### SEPTEMBER 11-18

International Congress of Generics (at Beilin) In three sections: General Genetics and Cytology, Heredity in Man and Eugenics, Animal and Plant Breeding.

International Society of Leather Trades' Chemists (Bi-Annual Conference) (at Leathersellers' Hall, St. Helon's Place, E C 3)

#### SEPTEMBER 12-15.

INSTITUTION OF PUBLIC LIGHTING ENGINEERS (Annual Meeting and Conference) (at Brighton)

#### SLPTEMBER 12-16.

British Mycological Society (Annual Meeting) (at Aviemore).

Monday, September 12 - Excursion.

Monday, September 12 — Excursion.
At \$ 45 r M — Council Meeting Exhibits
Tuesday, September 13 — Excursion.
At \$ 45 r M — Diff E J Butler Presidential Address.
Wednesday, September 14 — Excursion.
At \$ 15 r M — Annual General Meeting.
Thursday, September 15 — Excursion.
At \$ 45 r M — Diff M. Wilson \* Life-History of Milesina Kniegeriana and its Occurrence in Britain — Diff G. G. Hahn Species of Phomopsis occurring on Coniters and their Distinction in Gulture
Friday, September 16.— Excursion
At \$ .45 r M — Miss M Wilson \* The Dutch Elm Disease.— C Rea \* Remarks on Fungi found during the Foray

#### SEPTEMBER 12-17.

INTERNATIONAL CONGRESS FOR TESTING MATERIALS (at Amsterdam)

#### SEPTEMBER 15-17

Annual Conference of Women Engineers (at Shipping, Engineering and Machinery Exhibition)

Thursday, September 15, at 8 P.M.—Presidential Address at Olympia.

Priday, September 16, at 2 45—Discussion on the Relative Importance
of Commercial and Technical Engineering under Present-day Conditions. Commercial Side: Miss E. M. Kennedy, Technical Sate. Norah M Jeans

Saturday, September 17, at 2.15 (at Crosby Hall) - Miss Ins Cummins. Water Power and the Electrification of the Insh Free State.

#### SEPTEMBER 18-OCTOBER 3.

International Congress of Theoretical and Applied Limnology (at Rome). In four sections Physics and Chemistry, Geology and Hydrography, Biology, and Applied Limnology.

#### SEPTEMBER 20-22.

IRON AND STEEL INSTITUTE (Autumn Meeting) (at Royal Technical College, Glasgow), at 10 a.m.—Papers to be submitted.—D F Campbell: High-Frequency Induction Melting.—II. A Dickie: Magnetic and other Changes concerned in the Temper-Brittleness of Nickel-Chromium Steels—Prof. C. A Edwards and K. Kuwada. The Influence of Cold-Rolling and Subsequent Annealing on the Hardness of Mild Steel.—A. B. Everest, T. II Turner, and D Hanson: The Influence of Nickel and Shicon on an Iron-Carbon Alloy.—C. S. Gill: The Effect of Varying Ash in the Coke on Blast-Furnace Working—D. Hanson. The Constitution of Shicon Carbon Iron Alloys, and a New Theory of the Cast Irons—E. G Herbert: The Work-Hardening of Steel by Abrasion.—K. Houda and K Takahasi. On the Quantitative Measurement of the Cutting Power of Cuttery.—E. H. Lowis: The Use of Shica Gel as a Medium for Drying Blast.—T Matsushita and K. Nagasawa: The Mechansin of Tempering of Steels.—T. W. Robinson: The Economic and Social Development of the American Iron and Steel Industry—Dr. W. Rosenham and D. Hanson. The Behaviour of Mild Steel under Prolonged Stress at 300° C.—J H. Smith and F. V. Warnock: A Testing Machine for Repented Impact, and a Preliminary Investigation on the Effects of Repeated Impact, and a Preliminary Investigation on the Effects of Repeated Impact, and a Preliminary Investigation on the Effects of Repeated Impact, and a Preliminary Investigation on the Effects of Repeated Impact, and its Precipitation—F. Wust: A Contribution to the Theory of the Blast-Furnace Process.

#### SCPTEMBER 23-26.

Association of Special Libraries and Information Bureaux (at Trinity College, Cambridge) — Subjects for discussion Report of the Public Libraries Committee of the Board of Education (A. E. Twentyman and Lieut -Col. L. Newcombe); Recent Developments in connexion with the Science Library, South Kensington (Sir Henry Lyons); Information, Organisation, and Statistics in Industry (Major L. Urwick, S. J. Nightingale, H. Quigley, W. Wallace, A. E. Overton, F. W. Tattersall); Patent Classification (A. R. Wright, A. Gomme); Problems of the Information Bureau (A. F. Ridley, P. K. Turner, Dr. J. C. Withers); Photographic Reproduction of Printed and Ms. Material (N. Parley, Sir William Schooling, R. H. New); Standards of Book Selection in Science and Technology (Sir Richard Gregory).



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# The Imperial Agricultural Research Conference.

REAT BRITAIN is an industrial country; but the British Empire, of which it is the head and centre, is an Empire of agriculture, and of extraordinarily various agriculture conducted under extraordinarily various conditions sight there is little in common between the production of wheat, livestock, or fruit in England and the great Dominions, the growing of rubber in Malaya, of the oil-palm or ground-nut in India and West Africa, and of the sugar-cane or banana m the West Indies. But in truth all crop- or fruitgrowing and all livestock husbandry rest on the same fundamental principles, though their application may present a very different problem in different countries, and therefore all agriculture has at least one common interest—the elucidation of those principles

The Imperial Agricultural Research Conference, which is to meet in London at the beginning of October, will be primarily an attempt to survey and organise the scientific resources of the Empire for the increase of agricultural knowledge. Research has two main requirements—first (a long way first), trained men; and second, equipment. In both these requirements the Empire is, broadly speaking, far below the needs of the work to be done and the problems demanding a solutionproblems not of purely scientific interest but of immediate importance for the prosperity, and almost for the existence, of large populations. In Great Britain it is true that we possess, thanks mainly to Sir Daniel Hall, a coherent organisation of agricultural research institutes, reasonably staffed and equipped But outside Great Britain, and with a few exceptions, such as the Animal Diseases Station which Sir A. Theiler has established in South Africa, agricultural research, where it exists at all in any sense worthy of the name, is sporadic, ill-equipped, and un-organised. Yet in the tropical and sub-tropical colonies alone (without including the Dominions and India) there are something more than 2,000,000 square miles, and 50,000,000 people practically all dependent on agriculture of one kind or another.

No conference can provide men or money Money, however, is now available to some extent from the Empire Marketing Board, which is devoting to the encouragement of agricultural research a not insignificant proportion of its income; the provision of trained men is a matter of time, the offer of a career, and personal inspiration.

But the conference which meets in October can and will attempt to answer the question, "How can the different parts of the Empire best help one another in their common aim, the advancement of agricultural science?"

To those familiar with any kind of research, this general heading will suggest many specific problems. First and most important of all, there is the recruitment and training of research workers. It is well known that while in some branches of science there is a fair supply of young men coming forward to take up research, m others there is a lamentable deficiency; for example, from almost every part of the Empire there is a demand for trained geneticists, which is, and for the moment must remain, unsatis-For the solution of this problem we must look mainly to the universities of the Empire, and particularly of Great Britain. Again, what can be done to help the man now engaged in research? Is the time yet ripe for an extension of the principle already embodied in the highly successful Imperial Bureaux of Entomology and Mycology? For the establishment, for example, of Imperial bureaux of soil science, vetermary science, or agricultural economics? If so, on what plan should such new organisations be set up? Then there is the difficult problem of publications, and of the collection and interchange of information, so that a man examining an agricultural question on the Gold Coast, for example, may have at least a reasonable chance of starting with a knowledge of the work already done or being done in other parts of the Empire upon the same or connected problems.

The interchange of research workers is another matter to which a close analysis ought to be applied; if a definite and practicable scheme can be devised, there can be no doubt of its advantages. A man working alone or almost alone in a comparatively small tropical colony, far from the stimulus of companionship with his scientific fellows, must benefit enormously by a period of re-freshment (in the most literal sense of the word) at Cambridge, Rothamsted, or some similar centre; just as those who are fortunate enough normally to work in such centres may well obtain unexpected advantages from a complete if temporary change of surroundings, and the opportunity of applying the test of new conditions to hypotheses and results reached in laboratories and on land thousands of miles away. Another question of magnitude which can only be fully considered at a conference where the whole Empire is represented is the project of an Imperial chain of research stations-how many there ought to be, where situated, and how far each should endeavour to become the recognised authority for the whole Empire in one branch of agricultural science, besides meeting the imperative requirements of its own locality.

The conference must primarily apply itself to such administrative or semi-administrative questions; but naturally the groups of specialists present will discuss among themselves their own technical problems, which are scarcely suitable for the whole conference Possibly, however, the most valuable part of such a conference is not to be found in the official discussions of questions formally brought before the conference or committees of the conference; it is to be found in those private and unrestrained conversations in which one man of science really speaks to another with freedom about his own difficulties, hopes, methods, and The first Imperial Agricultural Research Conference is sure to be interesting, and it ought to produce most important results in the improvement of the machinery for the supply, equipment, and co-operation of men engaged in research. But one result should follow, which by itself will fully justify the conference; a mutual knowledge and personal appreciation between men scattered all over the British Empire, which will render their co-operation not only easier and more pleasant, but also more fruitful, than it can be made by any official machinery

#### Biometric Studies.

(1) The Biology of Population Growth. By Raymond Pearl. Pp. xiv + 260. (London: Williams and Norgate, Ltd., 1926.) 10s. 6d. net.

(2) Alcohol and Longevity. By Raymond Pearl. Pp xii+273. (New York and London. Alfred A. Knopf, 1926.) 15s. net.

THE present generation regards with relatively small alarm the probings of a paternal government into the life and death of the individual. Yet less than a hundred years ago the principle of laissez-faire was still dominant and the jurisdiction of Whitehall was strictly limited. No longer ago than 1753, a Bill introduced into the House of Commons to provide for a census of the people met with vehement opposition. One member "feared lest some public misfortune or an epidemical distemper should follow the numbering," while another was overpowered by the discovery that there could be "any set of men, or indeed any individual of the human species, so presumptuous and so abandoned as to make the proposal we have

just heard. I hold this project," he stated, "to be utterly subversive of the last remains of English liberty." Yet Great Britain did not lag behind other European States. The history of vital statistics is thus a short one, and, consequently, to glean further information of the populations of the past, we are compelled to resort to statistical assumptions based upon the very meagre data that exist

It is this ignorance of the course of population growth, of the variation in birth- and death-rates, over any but a very short period of time, and that limited mainly to a century of rapid industrial expansion, that makes the study of the 'laws of growth' so fascinating. Few workers have brought more originality to the study than Prof Raymond Pearl. Approaching the problem first from the mathematical viewpoint (in conjunction with Prof Lowell Reed), he concluded that a first approximation to the law was to be found in an equation of the form

$$y = d + \frac{k}{1 + e^{a_1 x + a_2 x^2 + a_3 x^3 + \cdots + a_n v^n}}$$

So long ago as 1838. Verhulst, a Belgian mathematician, had used this same curve, which he called the 'logistic curve,' as an expression of the law of population growth. This was unknown to Pearl and Reed when working on the problem, and they reached the result independently from biological reasoning. Eliminating mathematical symbols, Pearl states his 'law' as follows:

"Growth occurs in cycles. Within one and the same cycle, and in a spatially limited area or universe, growth in the first half of the cycle starts slowly but the absolute increment per unit of time *increases* steadily until the mid-point of the cycle is reached After that point the increment per unit of time becomes steadily smaller until the end of the cycle In a spatially limited universe the amount of increase which occurs in any particular unit of time, at any point of the single cycle of growth, is proportional to two things, namely: (a) the absolute size already attained at the beginning of the unit interval under consideration, and (b) the amount still unused or unexpended in the given universe (or area) of actual and potential resources for the support of growth."

Prof. Pearl shows that such a curve gives a good representation not only of the growth in body-weight of the rat and of the pumpkin, but also of the development of a population of yeast cells and populations of the fruit fly (Drosophila) kept under exact experimental conditions Applying the equation to human populations, it is found that the curve fits the recorded enumerations with extreme accuracy. Unfortunately, in all cases

the observed population-counts cover only a small part of the whole range of one cycle of growth In the United States and in England and Wales it is the earlier part of the cycle for which observations In France it is the late part of the cycle. What we require is a human population having census records covering an entire cycle of growth. This Pearl endeavours to supply by an analysis of the growth of the native population of Algeria, " the first and only example I have so far discovered of a human population virtually completing an entire single cycle of growth according to the logistic curve, and at the same time having definite census records covering practically the whole of the cycle" The 'fit' of the curve to the observed enumerations is again a good one. At the same time, we must not surrender ourselves entirely because of this 'goodness of fit' between the observed and the mathematically expected. Another curve of a flexible type may possibly fit the very limited observations equally well, but one has yet to be discovered based upon equally logical and justifiable reasoning

In adopting any 'law of population growth' it is essential to remember that it can be utilised for the estimation of past and future populations only over very short ranges of time. As Pearl points out, any alteration in the resources necessary for growth may entirely change the cycle along which a population is travelling. It was this change of resources that falsified (for the time being) the contentions of Malthus. He was unable to foresee the development of world-wide markets and the vast increase of food supplies, and thus the postponement of the pressure of population upon subsistence.

Pearl's experimental work is invariably stimulating, and his later chapters on density and population growth quicken one's interest. His data on normal sex behaviour cannot command the same respect. It is impossible to rid oneself of the conviction that no real assessment of the accuracy of the data is possible, and that a group of men aged from 50 to 75 years, even if of more than average intelligence, would not remember their average sexual activity per month in the different decades of life from puberty onwards Even if the data presented are substantially correct, the 'exposure to risk' incurred in all the social classes in this study is so great that one can scarcely credit the variation in sex habit as an important factor of the differential birth-rate

The same question confronts one in a lesser degree in reading Pearl's work on alcohol and the

duration of life. Can one ever obtain trustworthy knowledge of the drinking habits of the individual ? Pearl is satisfied that the information presented by him at least " is more accurate and comprehensive than any elsewhere available," and states that every critical safeguard of the accuracy of the records was adopted. He admits that it is by no means an easy matter to determine the precise effect of alcohol apart from other factors, and endeavours to eliminate the possible selective factor that determines whether a man is an abstainer or moderate drinker For this purpose he compares pairs of brothers, one an abstamer and the other a moderate drinker. The moderate drinkers, he finds, are slightly the better lives This is the same conclusion as that reached in the main study, that the moderate drinkers are as good lives as the abstainers, or even slightly better lives, while heavy drinkers are seriously penalised for their excesses as regards duration of life.

The study (and again more especially on its experimental side, of which a very detailed account is given) is full of interest and has been carried out with much care and labour. But it is not possible to feel satisfied that the selective factor has yet been proved to be non-existent, or that the last word has yet been said as to the effect of alcohol upon longevity—a dictum to which Prof. Pearl would be the first to subscribe A. B. Hill.

#### Religion in a Barbaric Kingdom.

Religion and Art in Ashanti. By Capt. R. S Rattray. With chapters by G. T. Bennett, Vernon Blake, H. Dudley Buxton, R. R. Marett, C G Seligman. Pp. xviii +414+116 plates. (Oxford: Clarendon Press; London · Oxford University Press, 1927.) 30s net.

THEN a magnificent feast is given and the numerous dishes are all excellent, it is perhaps ungracious to complain that the disorder of the courses makes digestion somewhat difficult, and that the table decorations (the appendices), though interesting in themselves, have not been arranged so as to decorate the table. Yet the excellence of his material provokes this complaint against the arrangement of Capt. Rattray's book. It is somewhat disconcerting to find the ideas of the soul, disease, and medicine all discussed under "funeral rites." So far as practical field method goes we would not change this at all; Capt. Rattray has derived all his knowledge from the sound method of watching ceremonies and discussing them with well-chosen informants, but it would have helped us to understand better had the ideas of the soul been given earlier, and not as an interruption to a ritual which had already begun. For an appreciation of Ashanti social, economic, and political organisation (as for most other 'socialled' savage societies) this knowledge of the spiritual background of life is essential, because religious ideas permeate everyday life and there is no trace of the division into civil and religious life that we are accustomed to in Europe. For example, law is founded on religious sanctions, just as the curious treatment of a new-born infant depends on the beliefs concerning the soul and the ever-powerful influence of the dead

It would seem that the one desire of the Ashanti is fertility, fertility of mankind and the fertility of the land, and for this end he must keep on good terms with the supernatural powers who are able to bless or blast the life source at every turn price, including human sacrifice, is too high to pay for the blessing, but for the Ashanti life is hard because of the multiplicity of supernatural powers. Capt. Rattray has defined these, not from any a priori conceptions of gods, demons or spirits. animism or mana, but from observation of ritual and the part the supernatural plays in the life of the individual. Thus there are the gods (abosom), including a High God in the sky, several gods, his children, all connected with water, an earth goddess, and possibly many others, the ancestral spirits (samanfo), and a vast class recognised by the Ashanti as suman, to which Capt Rattray reluctantly gives the name fetish. If he could, he would abolish that word entirely; instead, he has striven to correct the absurdly erroneous ideas of fetishism that have done so much to vitiate all works on West Africa. Some of the suman are extremely powerful, and it may be difficult for the observer to differentiate between their cult and those of gods, whereas other suman appear to be specially endowed amulets or talismans.

This, however, does not exhaust the catalogue of supernatural powers; there are forest spirits (fairies), monsters and witches, and animals and plants may have souls, which may influence the life of man. The description of a funeral service held over a dead elephant is very interesting, as the attitude here shown towards animals raises points in connexion with totemism. The usual socio-religious complex known as totemism does not exist in Ashanti, but there are certain animals and plants connected with the *ntoro* divisions (not clan divisions); lists of these *ntoro* animals and of animals possessing souls for whom funerals are

necessary are not identical, though there are a few species common to both Capt Rattray does not appear to have followed up this possible connexion, and it is quite probable that it would not lead to any conclusions, but it is a nice indication of the mental attitude towards animals which makes totemism possible.

The king of Ashantı does not appear to be a divine king; rather does the divinity of the authority rest in the king's stool or throne Much insight into the Ashanti religion and its relation to the kingship may be gained from the description of the Odwira ceremony, previously known as the Yam custom, and famous for the amount of intoxicating liquor drunk and of human blood These two features, though so horribly prominent to the first European observers, are merely incidents to the Ashanti in what was really an annual purification ceremony for the king and the whole nation before the new harvest might be The king honours the ancestral spirits, and the chiefs and people pay allegiance to the king The gods, ghosts, and other spirits must eat, then the king, his chiefs, and people may do so ceremony, which lasted many days, must have been of great political and economic value to the kingdom It seems a pity, however, to call it a "rite de passage," a title which so aptly classifies those ceremonies connected with transition periods in the life of the individual which mark the various phases of personal development, although M. Van Gennep himself, who coined the phrase, did include certain seasonal festivals under this heading.

The cult of the dead kings of the Ashanti suggests interesting politico-economic questions, for in addition to the extremely complicated beliefs concerning the soul, or rather the various souls that go to the spirit world (in the case of the king accompanied by widows and other attendants who are killed for that purpose), there is also a cult of the royal skeletons, to each of whom is appointed a living wife. Moreover, vast treasury in gold was owned by the dead kings and guarded by a standing army of about one thousand men This moneyfor gold dust has its standard weights and values in Ashanti-could be 'borrowed' by the reigning king for ceremonies or national emergencies. The fact that the king must borrow and not merely take the royal treasure may have given stability to the government and added to the credit of the country.

It is to be hoped that Capt Rattray may still be able to obtain further information concerning this

primitive gold reserve. Was tribute paid to the dead and not to the living monarch, or was it divided between them? In what manner did the king make repayments to the coffers of the dead, and at what periods? Were the natural sources of gold controlled in any way, or might any man wash for alluvial gold? Numerous examples are given of fines which must be paid in expiation for breaking taboos or in the more ordinary course of justice, but it is not always clear if these were due to the king, clan chief, gods, or as compensation to the injured party One notable example of direct taxation, however, is that half the bride-price of daughters of the royal house, as well as of granddaughters and great-granddaughters of chiefs, passes to the king

Apart from the practical functioning of the gold reserve, there is an interesting question regarding its underlying purpose and possible origin, on which it may still be possible to throw light Capt Rattray has told us that when a commoner is buried, his wife provides some gold dust, or a small nugget, which is tied in the loin-cloth of the deceased. It is called kra sika, 'soul's money,' and is intended for the purchase of necessaries in the world of ghosts. Is it possible that the treasury of the kings originally served the same purpose, or that even quite recently, while fulfilling an entirely different function, the same belief was held with regard to it? It is to be hoped that in the forthcoming volume which Capt. Rattray promises us, he may be able to tell us still more about the economic side of this highly organised barbaric kingdom. All who have enjoyed Capt. Rattray's first work on Ashanti will appreciate this, his second volume, and will look forward eagerly to the publication of the third.

Brenda Z. Seligman.

#### Chinese Ornithology.

Bulletin of the Peking Society of Natural History.

Technical Series, No. 1. A Tentative List of
Chinese Birds. Part 1 · From Colymbiformes
through Coractiformes. Compiled by N. Gist Gee,
Lacy I. Moffett, and G. D Wilder. Pp. viii
+144. (Peking: Peking Society of Natural
History, 1926.) n.p.

IN Great Britain it seems as if almost every nature-lover who can wield a pen writes, or tries to write, a work on British birds. In China the reverse is the case, and since 1877, when David and Oustalet brought out their "Birds of China," no one has attempted to compile another such

publication Latouche is now engaged on "Birds of Eastern China," and both he and Lord Rothschild have written several valuable articles in the Ibis on the birds of Yunnan, whilst desultory articles on the avifauna of other portions of the great Chinese Empire have appeared from time to time in the same and in other journals. Messrs N Gist Gee and his collaborators are now bringing out a tentative list of the birds of the whole Chinese Empire, and we congratulate them very heartily on this part, the first, which has appeared in the Bulletin of the Peking Society of Natural History The work is one which is very badly wanted, for however good David and Oustalet's work was when written, it is now long out-of-date, and a vast amount of ornithological work has been done since that time. The tentative list will, as its name implies, include all those birds which occur in the eighteen provinces of China, its islands, and in eastern Mongolia, east to Sakhalin.

The classification adopted is that of Knowlton in his "Birds of the World," and the nomenclature is taken from Hartert, "Die Vogel Palaarctischen," and other modern authors No suggestion is made that the list is in any way complete but, such as it is, it is published as a working basis for further study and, in this respect, it is almost impossible to over-estimate its value to both present and future workers The list contains the scientific, English and, wherever possible, the Chinese name of each bird, after which its distribution is given. The author of each scientific name is given, but no reference is made either to the first description or to later synonymy, an omission to be regretted. though the inclusion of these details would doubtless have at once overburdened the work and rendered it impossible to carry out.

It is out of place in reviewing a work of this nature to criticise minor details, and it may suffice to say here that as a whole the compilation appears to be excellent and thorough, and the fact that mistakes in nomenclatures and a few inaccuracies in geographical ranges naturally find their way into its pages will not in any way affect its immense usefulness and its great influence in furthering the cause of Chinese ornithology. It is a praiseworthy and very ambitious attempt to fill a greatly felt want, and one which we hope will probably inaugurate another cycle of ornithological research in China. The present volume contains the Colymbiformes, storks, herons, ducks, Accipitres, game birds, rails, waders, gulls, pigeons, and scansorial birds, leaving the great order of Passeres still to be dealt with.

No. 3020, Vol. 1201

#### Anatomies: Comparative and Human.

- (1) Vergleichende Anatomie der Wirbeltiere Von Prof J E W. Ihle, Prof P. N. van Kampen, Prof. H F Nierstrass, Prof J Versluys. Aus dem Hollandischen übersetzt von G Chr. Hirsch. Pp viii + 906. (Berlin Julius Springer, 1927.) 66 gold marks
- (2) A Laboratory Manual for Elementary Zoology. By Libbie Henrietta Hyman. Second edition Pp xviii + 182. (Chicago, Ill. University of Chicago Press, London. Cambridge University Press, 1926.) 128 6d net
- (3) The Spiny Dogfish · a Laboratory Guide By Dr. Alvin R. Cahn Pp xiii+94 (New York . The Macmillan Co., 1926) 5s
- (4) Necturus: a Laboratory Manual. By L A Adams. Pp. vm + 72 (New York: The Macmillan Co., 1926.) 4s. 6d.
- (5) Anatomy of the Wood Rat Comparative Anatomy of the Subgenera of the American Wood Rat (Genus Neotoma) By A. Brazier Howell. (Monographs of the American Society of Mammalogists, No. 1.) Pp. x + 225 + 3 plates (Baltimore, Md · Williams and Wilkins Co., London Baillière, Tindall and Cox, 1926.) 228 6d. net
- (6) An Atlas of Human Anatomy: for Students and Physicians. By Dr. Carl Toldt, assisted by Prof. Alois Dalla Rosa. Adapted to English and American and International Terminology by Dr. M. Eden Paul. Revised edition in 2 vol. Vol. 1 First section, A. The Regions of the Human Body, B Osteology; Second section, C: Arthrology, Third section, D: Myology. Vol 2. Fourth section, E: Pp. iv +400Splanchnology, Fifth section, F. Angeology, Sixth section, G: Neurology; H The Organs of the Senses. Pp. ii + 401-985. (New York. The Macmillan Co., 1926.) 42s. net
- (1) THE German translation of a treatise on comparative anatomy by four Dutch zoologists is a welcome summary of the present state of vertebrate anatomy, which deals with vertebrates in the same way as, but more fully than, Gegenbaur and Bütschli have dealt with the animal kingdom as a whole. Some of the illustrations are borrowed from Bütschli's text-book, the merits of which have already been described in NATURE; and the rest of the 987 figures are drawn in the same clear semi-diagrammatic way. The volume is probably the best text-book of comparative anatomy. The chapter on the skeleton (by Prof. Versluys, of Vienna), dealing as it does not only with recent but also with fossil vertebrates,

is worthy of special note for its excellence and comprehensiveness

- (2) The fact that Hyman's "Elementary Zoology" is the second edition of a practical manual of which seven impressions have been sold in six years leaves no doubt as to its usefulness in the University of Chicago. It deals in a comprehensive way with the technique of the practical examination of the anatomy, embryology, and cytology of a large series of invertebrates and vertebrates. It has no illustrations
- (3) and (4) The guides to the dissection of the dogfish and Necturus are simple, clearly written dissecting manuals for elementary class work. They are both well done, but have no illustrations.
- (5) Howell's work on the wood rat is an original memoir on the anatomy of a common American mammal The author points out that while there are excellent accounts of the anatomy of such spectacular curiosities as the aye-aye and the marsupial mole, we are woefully ignorant of many of the common mammals His book is one of a series that is being issued by the American Society of Mammalogists to make good this defect work provokes comparison with the investigations of the tree shrew and the tarsier respectively by Profs. Le Gros Clark and Woollard, recently published by the Zoological Society of London, and such a comparison reveals the curious fact that the American author has wholly neglected the central nervous system, to which the British anatomists devote particular attention
- (6) Toldt's well-known atlas of topographical anatomy is perhaps the most comprehensive of the many atlases now available for students, and as such is well worth making accessible in this second edition for English-speaking readers. While most of the illustrations are excellent, a few of the wood blocks seem to be worn out so that the detail is lost in the impressions made from them. Dr. Eden Paul's contribution to the volume is not altogether relevant: his reliance upon Macalister's text-book, which was an excellent guide more than thirty years ago, is not an adequate basis for the explanation of a modern atlas.

#### The Chemistry of Wood.

The Chemistry of Cellulose and Wood. By Dr. A. W. Schorger. (International Chemical Series) Pp. xiv+596. (New York. McGraw-Hill Book Co., Inc; London: McGraw-Hill Publishing Co, Ltd., 1926.) 30s. net.

IN organic chemical industry there are many signs of wider and increasing activity. Synthetic alcohols are leading to new supplies of solvents and

other products, and in addition the possibilities of wood as a chemical raw material are being realised Within the last decade artificial silk from wood has become abundant and cheap, and is now being used to an extent never approached by the limited and costly natural silk The saccharification of wood and cellulose has recently become prominent as a possible cheap source of power alcohol, acetone, glycerine, and other products of fermentation, and although not without technical difficulties, promises to open the way to new industries In addition to these prospects there is every likelihood that wood cellulose will be pressed into use as a substitute for the more costly cotton cellulose in many existing industries such as film, celluloid, explosives and enamels

Wood, unlike coal and oil, requires only land and the sun for its continuous supply. Fortunately, reafforestation is receiving active attention in Great Britain, as in the main timber-producing countries, and there is no doubt that many requirements can be assured with practically small land reservations. The chemistry of wood and wood cellulose is consequently of increasing importance. Considerable attention appears to have been directed to the subject by the study of wood as a source of explosives during the War

Wood and its products are, however, complex and varied, and a systematic conception of their chemical and physico-chemical behaviour has been wanting. Dr. Schorger, Director of Chemical Research, C. F. Burgess Laboratories, has carried through successfully the difficult task of collecting the scientific data available on the chemistry of wood in a concise account, necessarily including some mention of cotton cellulose and its modified forms. It is made clear in the preface that the technical side of the subject is not the main theme, but the research student and worker will find the literature effectively summarised, while new prospects of research are to be found on almost every page of the book.

Broadly, the subject matter covers wood and the reactions of wood, lignin, hemicelluloses, gelatinised cellulose, oxy- and hydrocelluloses, the saccharification, distillation, and digestion of wood and wood celluloses, and analytical methods, concluding with a useful author and subject index. The many problems of chemical constitution, together with modern views on gelatinisation and other physical phenomena, are fully considered, while manufacturing processes concerned with wood and wood cellulose are adequately, although more generally, described.

In such a summary it is inevitable that occasional erroneous results can be found and additions suggested Thus, Jentgen's statement that dry cellulose will take up 3 per cent. of moisture from all known drying agents is obviously incorrect and should be omitted. The following corrections might also be made. on p 536 amiline hydrochloride to aniline acetete, on p 578, under copper number, 451 to 541, and on p 184, Irvine's formula for cellulose is incorrectly reproduced. The paper, printing, and binding are excellent, and the work is to be recommended as the most satisfactory survey of the subject in a convenient handbook form

A FORSTER

#### Our Bookshelf.

Department of Scientific and Industrial Research The Cleaning and Restoration of Museum Ex-Third Report upon Investigations conducted at the British Museum. Pp. v+70+58 (London. H M Stationery Office, 1926.) plates 5s. net.

CURATORS of museums as well as private collectors not infrequently find some or other of their charges incapable of resisting, unaided, the ravages of time in their many forms. In this volume, which amplifies two previous reports, Dr. A. Scott describes his experiences in the cleaning, restoration, and subsequent preservation of various exhibits from the British Museum and of some other well-known objets d'art. Sections of the book are devoted to prints and pictures, to stone and earthenware, to objects of silver, iron, lead, copper, bronze and wood, and to textiles; there are also described and illustrated some interesting 'fakes,' founded on a genuine basis and so cleverly executed as to deceive even experts until some abnormal feature of decay suggested the necessity for detailed scientific examination. The text concludes with some notes of a general character, dealing with apparatus, utensils, and media likely to be of value for specific purposes.

While the cleaning and restoring processes should preferably be left to skilled hands, the amateur, by adherence to the methods laid down, should be able to achieve satisfactory results. The timely admonition against the use of preparations of unknown composition is one which may well be extended to spheres other than that with which

we are now concerned.

The efficacy of the methods adopted is illustrated by a number of well-produced, interleaved plates showing in many cases the various subjects before and after treatment, and on occasion some other point of particular interest.

Here, then, is a book almost unique of its kind and invaluable to those for whom it is primarily intended; further, it should serve, in these days of the revival of 'general knowledge,' to stimulate the interest of a larger sphere of readers in a number of cognate subjects.

Handbook of Non-Ferrous Metallurgy Prepared by a Statf of Specialists Donald M Liddell, Editor-in-Chief In 2 vols Vol 1 Pp x1+692 Vol. 2 Pp v+693-1440 (New York. McGraw-Hill Book Co., Inc., London McGraw-Hill Publishing Co , Ltd , 1926 ) 60s net

There are many encyclopædic text-books of metallurgy, and a new one must justify itself by fullness and accuracy of treatment The present volumes are the work of a large number of contributors, and there is no attempt to give a critical Instead, there is a series of survey of the subject monographs on the metals, most space being given to those which are of the greatest industrial im-Each monograph is by a specialist, so that the information may be supposed to be abreast of modern practice This appears to be true of the common metals, and such important processes as the electrolytic extraction of zine are treated in detail. The term metallurgy has been interpreted by most of the writers as referring mainly to the extraction of the metals, and only in a few instances is there more than a brief outline of mechanical or thermal treatment or of the preparation of alloys. Such general processes as crushing, ore concentration, roasting, sintering, and electric smelting are considered in separate articles as well as meidentally under the heads of the several metals extensive and useful section deals with the materials of metallurgical construction Metallography only receives limited attention, and the brief article on the subject is mainly confined to phase-rule questions, but a few of the authors give some account of the metallography of their special section. Throughout the greater part of the book theory is subordinated to practice, and it is mainly as a guide to current ore-dressing and smelting practice that it will be found useful. The least satisfactory section is that which deals with the rarer metals, in which there is now a great metallurgical interest.

The Geography of Witchcraft. By Montague Summers (The History of Civilisation Series.) By Montague Pp xi+623+8 plates. (London. Kegan Paul and Co, Ltd.; New York. Alfred A. Knopf, 1927.) 21s net.

"THE Geography of Witchcraft," the title by which Mr Summers distinguishes the second of his studies of witchcraft in this series, is something of a misnomer. Except that his chapters have geographical headings, his treatment is purely historical Further, he deals only with Greece and Rome, England, Scotland, New England, France, Germany, Italy, and Spain An adequate geographical study of witchcraft should surely go farther Even within the boundaries of Europe he has omitted areas which are of first-rate importance in any investigations of the distribution of the belief and of special significance in relation to the question of origins. In Scotland, for example, where Mr. Summers notes that even the fairies have a sinister character, there seems to be a convergence of two lines of development, one coming from the north of Europe and the other from the south.

The explanation of the restriction which the author has imposed upon himself no doubt is to be tound in the fact that his interest lies in the theological side of his subject. He has therefore confined his attention to those countries in which the witch is to be regarded as a subject under the ban of the Church and a heretic, rather than as a survival from an earlier stage of culture. In this volume, as in the preceding, due allowance must be made for the author's strong theological bias, but so far as the facts are concerned, his account for each of the countries with which he deals is comprehensive, detailed, and accurate to a degree beyond that attained by any other book on the subject

A Botanist in the Amazon Valley. an Account of the Flora and Fauna in the Land of Floods. By Prof R Ruggles Gates Pp 203+11 plates (London H. F. and G Witherby, 1927) 7s 6d net

The opportunity of a voyage up the river Amazon so far as Teffé, which, including stays of a few days at Para, Manaos, and Teffé, occupied about six weeks, has led Prof. Gates to give an account of the general scenery and vegetation which can be seen from the deck of steamers and from his brief visits To any one making the journey by to terra firma one of the Booth line boats and river steamers, this narrative by a botanist will be of interest, but for the serious student Prof Gates adds very little to our knowledge, and he himself is undoubtedly the chief gainer by this very interesting opportunity, of which he appears to have taken full advantage, judging from his frequent allusion to his impedimenta for collecting, etc The book appears to be the author's diary in print, so that much similar information is repeated, but a good many items will be of value to others who may make the journey. We are surprised that Prof. Gates compares the

We are surprised that Prof. Gates compares the huge leaves of the *Victoria Regia* with their vertically upturned edges to dinner plates; nor is he correct as to the colour of the flowers, since they are pure white at first and turn pink in the course of the day and then dull crimson as they fade. Two short chapters at the end of the book on palms and other trees of the Amazon, and on woods and timbers of this region, are of value.

Sternhaufen: ihr Bau, ihre Stellung zum Sternsystem und ihre Bedeutung für die Kosmogonie. Von P. ten Bruggencate. (Naturwissenschaftliche Monographien und Lehrbucher, Herausgegeben von der Schriftleitung der Naturwissenschaften, Band 7) Pp v + 158 + 4 Tafeln (Berlin: Julius Springer, 1927) 15 gold marks This is a very comprehensive monograph dealing with star-clusters and the work of various investigators on the problems of their distribution in space and of their structure. In Part 1 the author gives the general distribution of the clusters in the sky and describes the methods employed by Charlier, Kapteyn-Schouten, and Shapley for determining their distances. Parts 2 and 3 are devoted to investigations on the arrangement of the component stars of the clusters and the

dynamical problems involved. The work of Eddington, Jeans, Shapley, and Von Zeipel naturally forms the framework of the chapters included. In Part 4 the author considers the question of star-clusters in relation to a general scheme of cosmogony. As this monograph is intended essentially for students, references to original papers are given in footnotes. In the list of catalogues of star-clusters, reference should have been made to that compiled by Melotte from the Franklin Adams Chart, and published as Memoirs of the Royal Astronomical Society, vol. 60

Through Kamchatka by Dog-Sled and Skis: a Vivid Description of Adventurous Journeys amongst the Interesting and Almost Unknown Peoples of the most inaccessible Parts of this remote Siberian Peninsula. By Dr. Sten Bergman Translated from the Swedish by Frederic Whyte Pp 284+16 plates. (London: Seeley, Service and Co, Ltd, 1927) 21s net.

In this book Dr Bergman describes several journeys which he and his wife took a few years ago in the interior of Kamchatka, when he was leader of a biological and ethnographical expedition sent by the Swedish Geographical Society is the best kind of travel book, with no tedious details of daily routine, but enough incidents of travel to illustrate the customs and habits of the people and the difficulties of the road. There is also much original matter in the account of visits paid to the Lamuts and Korvaks in the remoter parts of the peninsula, and to the degenerate and disappearing Kamchadals. The book is useful as giving a full and readable account of a part of Asia which is little known and seldom visited except by trappers and fur dealers. The maps and illustrations add to its value Fuller accounts of the results of the expedition are now being published in Swedish scientific journals.

Delineations of American Scenery and Character. By John James Audubon With an Introduction by Prof. Francis Hobart Herrick Pp. xliv+349. (London: Simpkin, Marshall and Co, Ltd, 1926.) 18s. net.

Audubon's "Ornithological Biography," as he called the text in five volumes which accompanied his great work on "The Birds of America," contained a number of descriptive articles of a general value. Fifty-nine of these essays and two of his prefaces are reprinted in this volume, to which his biographer adds a short introduction Most of the essays are sketches of pioneer life in the Ohio and Mississippi valleys, Labrador, Newfoundland, and New England between 1808 and 1834 A few treat more particularly of animal life. They were all written in the places and among the scenes they describe and portray vividly many aspects of life in America that have now passed, submerged in the flowing tide of population. Thus they fulfil the writer's aim, which was to record America as he saw it before man effected drastic changes on the face of the country. The volume is a useful contribution to American natural history and geography.

#### Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can be undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

# The Actinium Series and the Order of Stability of Radioactive Isotopes.

One of the outstanding problems of radioactivity is the exact relation of the actinium to the thorium and uranium-radium disintegration series. That the actinium series starts at uranium I or an isotope of uranium, includes uranium-Y and ends at an isotope of lead after five a-particles have been expelled between protoactinium and the end product is regarded as proved by the experimental evidence But the atomic weights of members of the series are not known, protoactinium is the only member of the series whose atomic weight might be determined by the usual methods, but this constant is still lacking owing to the very great difficulty of making a complete separation of protoactinium from its homologue tantalum An investigation with the mass-spectrograph of uranium or of uranium-lead, leading to the discovery of isotopes not ascribable to the uranium-radium series, might also throw light on the atomic weights of members of the actinium series. This has yet to be made.

Failing experimental evidence, it may be asked if any useful purpose is served by attempts to predict what these atomic weights may be. As they lead not only to new values of these atomic weights but also to a generalisation with respect to the stability of radioactive isotopes which in part is applicable to isotopes of mactive elements, as I hope to show they do, I think they are justified.

I assume (a) that the actinium series starts from an isotope of uranium, ends at an isotope of lead, and includes the product uranium-  $\Gamma$ , for all of which the experimental evidence is very strong; (b) that if an element of even atomic number has isotopes of odd atomic mass, these are likely to be one and three units less than the mass of its most stable isotope; (c) that the most stable mass of an element of odd atomic number is likely to be one unit greater than that of the most stable mass (of even number) of the element next below it. (In (b) and (c) I am merely applying to elements in the range of atomic numbers 82-92 what is obvious from  $\Gamma$ . W. Aston's results on elements in the range 34-80)

Now the most stable isotopes of elements 92, 90, 88, 82, and 80 are known to have masses 238, 232, 226, 208, and 202 respectively. Therefore according to (c) the most stable isotopes of elements 93, 91, 89, 83, and 81 are likely to have masses of 239, 233, 227, 209, and 203 respectively. (This is certain for element 83 and very probable for element 81.) Can protoactinium have the atomic mass 233 assigned to the principal isotope of element 91 ? Now, so far as has been investigated, the most stable isotopes of elements 92, 90, 88, 8 $\check{6}$ , 84, 83, 82, and 81 are either 'a-rayers' of long life or products which may be described as potentially 'a-rayers' (bismuth 209 being regarded as the parent of thallium's isotope 205, lead's isotope 208, the parent of mercury's isotope 204, etc.). Proto-actinium, an ' $\alpha$ -rayer' with an estimated period of 10,000 years, is clearly in this class; actinium, a ' $\beta$ -rayer' with a period of 20 years, is clearly not. The former may therefore have an atomic mass of 233, the latter may not have an atomic mass of 227; and these two statements are consistent with one another,

since the former element is the paient of the latter by an a-particle change.

An alternative value for the atomic mass of protoactinium would be 235, since, as F. W. Aston's results. show, an element of odd atomic number may have a second isotope two units greater m mass than that of the principal isotope. The value 233, however, leads to a value of 237 for the mass of that uranium isotope which is the head of the actinium series, a value consistent with assumption (b), whereas the value 235 leads to a value 239, which is not. Again, as the mass 227 may not be assigned to actimum, the mass 231 may not be assigned to protoactinium If, therefore, the atomic mass of protoactinium is an odd number, that mass must be 233 if the assumptions I am making are valid. This value fixes the atomic weights of the remaining members of the series unless it can be shown that a further a-particle which has been overlooked, or a massive particle other than an α-particle, is expelled by some member of the series

Formerly I regarded the actinium series as beginning on a uranium isotope of mass 239 or 235 and ending at a lead isotope of mass 207. This view was suggested by the fact that the transformations ionium to radium-B, radiothorium to thorium-B, and radioactinium to actinium-B, are all similar as regards the radiations expelled, and in that each product in these transformations has a period on the average 800 times smaller than that of its parent, and yet the average rate of decay of products of the first transformation is  $7.5 \times 10^3$  times that of the corresponding products of the second and that of the second about 40 times that of the corresponding products of the third.

I argued that as the factor  $7.5-10^3$  corresponds to a difference in mass of the isotopes of 2, then its square root (of the same order as 40) corresponds to a difference in mass of 1. I concluded, therefore, that if x, x = 2, x - 4 represent atomic masses, and the first and second those of, say, ionium and radiothorium respectively, the atomic mass of radioactinium would be not x - 4 but x - 3.

This implies, I see now, that the decreasing order of stability of the masses is x, x-2, x-3, x-1. But if this order were x, x-2, x-1, x-4, as I hope to show it is, then the proper conclusion from this relation between the periods is that the atomic mass of the actinium product is x-1, not x-3. The mass of radioactinium should be therefore 229, not 227, and, in consequence, that of every actinium product should be 2 units higher than I formerly thought.

If protoactmum has an atomic mass of 233 the masses of actinium products of elements 92, 91, 90, 89, and 88 are known, and their stabilities may be compared with the corresponding products of the radium and thorium series. Two empirical relations appear to connect stability, as measured by half-value period, with mass.

I. For an element of even atomic number the masses of its  $\alpha$ -ray and of its  $\beta$ -ray isotopes are in decreasing order of stability when arranged in the orders x, x-2, x-1, x-4, x-3, etc., respectively, x being an even number and the

atomic mass of the stablest isotope

II For an element of odd atomic number the masses are in decreasing order of stability when arranged in the same order as the  $\beta$ -ray isotopes of an element of even atomic number, x the atomic mass of the principal isotope is, however, an odd number. (For all radioactive elements the isotope of mass x is an 'a-rayer'; for a comparison of its stability with that of its  $\beta$ -ray isotopes, however, it may be conventionally regarded as a ' $\beta$ -rayer' of very long period and therefore of very great stability.)

For element 92 the decreasing order of stability is uranium I (238), actinouranium (237), uranium II (234), by rule I it is 238, 236, 237, 234, 235. For element 91 the same order is protoactinium (233), uranium-Z (234), uranium- $X_2$  (234); by rule II. it is 233, 235, 234, 237, 236. For element 90 the order is thorium (232), ionium (230), radiothorium (228), radioactinium (229) for 'a-rayers'; by rule I. it is 232, 230, 231, 228, 229, for ' $\beta$ -rayers' the order is thorium (232), uranium- $X_1$  (234), uranium-Y (233); by rule I. it is 232, 234, 233, 236. For element 89 the order is stablest isotope (227), actinium (229), mesothorium-2 (228), by rule II. it is 227, 229, 228, 231. For these four atomic numbers, then, the rules give values consistent with the known or assigned values of all the known isotopes.

A more general torm of these rules holds for the isotopes of several of the mactive elements investigated by F. W. Aston. Granted that an element of even atomic number has one or more isotopes of odd mass number, then it is to be expected that (a) the even mass numbers may be arranged in order of decreasing stability in two series. one, in which the mass numbers increase uniformly from the mass number of the principal isotope, and the other in which the mass numbers decrease, (b) any odd mass number (capable of existing) when arranged with the even mass numbers in decreasing order of stability, follows the mass number one unit greater in an 'increasing series and the mass number one unit less in a 'decreasing' series. For example, the experimental decreasing order of prevalence in Nature (here regarded as the criterion of stability) of the isotopes of selenium is 80, 78, 76, 82, 77, 74. The 'increasing' series is 80, 82, the 'decreasing' 80, 78, 76, 74, and the odd mass number follows 76, as it should according to the general form of the rule

Again, the experimental order for the isotopes of xenon is 129, 132, 131, 134, 136, 128, 130, which is nearly consistent with the orders given by the rule. 129, 132, 131, 134, 136, and 132, 130, 128. Of the elements investigated by F. W. Aston the experimental order of decreasing stabilities of isotopes is consistent with those given by the rule for sulphur, selenium, krypton, neodymium, and lead, is nearly consistent for xenon, cadmium, and mercury, and is meconsistent for tin and the light elements magnesium and silicon.

In element 84, despite the fact that polonium has the longest period, the order of decreasing stability of the remaining isotopes is radium-A (218), thorium-A (216), actinium-A, radium-C' (214), and thorium-C' (212) By rule I. the atomic mass of actinium-A should, therefore, be 217, and this leads to a value for the atomic mass of 209 for the end-product.

In element 83 the stabilities of the three C-products may be compared first as ' $\alpha$ -rayers' and secondly as ' $\beta$ -rayers' According to the rules, in the former case an atomic mass of 213 or 211 is suggested for actinium-C; in the latter case a mass of 213. These values lead to values of 209 and 207 respectively for the atomic mass of the end-product.

In element 82 rule Î. fixes the atomic mass of actinium-B as 211; for a mass of 213 the half-value period of actinium-B should be less instead of, as it is, slightly greater than that of radium-B; the value 211 leads to a value of the atomic mass of the end-product of 207.

Finally, in element 81 rule II. gives possible values of 209 and 207 to the atomic mass of actinium-C", which lead to values of 209 and 207 respectively for the atomic mass of the end-product. On the whole, the application of the rules to these four elements, though not satisfactory, points to a value of the atomic

mass of the end-product of the actinium series of 209 rather than 207. This is, of course, the value to be expected if protoactinium has an atomic mass of 233, and if there is no abnormal particle expelled by actinium-X or other member of the series.

A S. Russell.

Christ Church, Oxford, Aug. 18.

## On Incomplete Spawning and the Problem of Fertilisation in *O. edulis*.

DURING recent investigations on the relation of spawning in the native oyster (O edulis) to external conditions, certain phenomena, which it is advisable to record early, have recently been observed

At the end of the new moon tides at the end of July and in the beginning of August (1927), there was a fair to heavy general spawning of oysters (O. cdulis) on the beds in the upper part of the Fal In this general spawning it was observed that a large proportion of the spawning individuals had (apparently) tailed to fertilise a large proportion of their eggs, varying in individuals from 20 per cent. to 60 per cent, with occasionally a higher proportion. The successfully fertilised eggs were found in the condition of development of 1, 2, or 3 days old embryos, while the unsegmented eggs showed at the same time great variation in size, and in many cases, but in small proportion, a variable number of nuclei to as high a number as 13 Unsegmented eggs contaming many nuclei may be associated with either polyspermy, or with conditions which prevent segmentation after fertilisation, or may possibly also occur as a result of degenerative changes in the unfertilised egg.

It is a fact, however, that there has been a large wastage of oyster eggs on the Fal Estuary oyster beds at the critical spawning time in early August.

At the same time as it was found that a high percentage of eggs remained unsegmented, due apparently to not being fertilised, it was noticed that the percentage of incompletely spent female individuals had increased from an average of about 10 per cent to 17 per cent. (in comparable samples each amounting to 700 individuals), so that eggs in considerable quantities have also been lost from an inefficient response to the spawning stimulus

The incomplete spawning of female oysters has previously been shown to be not uncommon (Jour. M.B.4., vol. 14, p. 974, 1927), and elsewhere (Fish. Invest., London, vol. 6, 3 and 4; 1924) that unspent ova may either remain in the gonad to produce a 'curdled fish,' and become absorbed later, or be excreted in masses on to the shell and covered with a calcareous deposit to form what Mr. Haynes, I believe, was the first to describe as an 'excretion blister.' The large proportion of incompletely spawned females recently found among the Fal Estuary oysters is nevertheless unusual, as is illustrated by the occurrence of only 2 to 6 per cent. incompletely spent individuals in more than 7 comparable samples of 100 oysters examined at the same time from West Mersea, Essex. In one sample of 100 individuals from Thornfleet, West Mersea, however—and currously on Aug. 2-there was the unusually high percentage for 1927 of 12 incompletely spawned. (These percentages are accumulative from the beginning of the spawning season)

The incomplete natural spawning of female oysters can probably be explained satisfactorily as a result of normal natural causes, and is probably always relatively high in the Fal Estuary. It seems highly probable that the phenomenon is due to the occur-

rence of temperature fluctuations at about the spawning period. Thus, this year it was found that the temperature over the Upper Fal oyster beds fluctuates to an unexpected extent with the neap and spring tides; for example, on July 27 temperatures over the beds generally ranged from 62° to about 63° F., the temperature being about 62° at 8½ fathoms at about low water above Turnaware Bar. Aug 3 at the same station at the same depth at half ebb-tide the temperature was below 60° and less that 59° at 14 fathoms at the lower end of the oyster beds. A similar fluctuation was observed in the succeeding neaps and springs, and on Aug. 17 the remarkably low temperature of 57° was recorded m 14 fathoms at the lower end of the beds, with a corresponding reduction in temperature over the whole of the beds It is clear, therefore, that at the spring tides relatively cold water sweeps directly into the Fal Estuary and over some parts of the oyster beds from the deeper parts of the English Channel, while during the neap tides the tidal oscillation of water is reduced and in summer weather the water becomes relatively warm. It is not possible, however, to discuss these matters and their bearing on spawning fully here.

In samples of oysters from the Fal Estuary, examined from one week to a fortnight after the abnormal spawnings were observed, individuals were found carrying normal shelled larvæ and at the same time a small proportion of much smaller and frequently abnormal shelled larvæ, the latter no doubt being the product of the fertilisation of scarcely ripe eggs; as the abnormal larvæ will probably not live, there will be additional loss of some of the eggs which were

fertilised.

It would seem, therefore, that at the period of the new moon tides at the end of July in 1927 on the Fal Estuary oyster beds, there was a powerful stimulus exerted on oysters to spawn, and that a large proportion of those female oysters, which were approaching maturity, spawned either incompletely or apparently before collecting sufficient sperm to fertilise their eggs Since normally segmenting embryos occurred alongside unsegmented eggs in the mantle cavity of the same individual, it is not necessary to infer that abnormal substances in the seawater have interfered with and affected the process of fertilisation. On the other hand, the occurrence of large numbers of unsegmenting eggs in a high proportion of the spawning oysters on beds which are depleted in numbers necessarily raises the question as to whether enough male-functioning oysters exist in the locality to supply the relatively widely scattered It is possible that not enough sperm had been emitted by the oyster population to enable those females ripening at the end of July and in early August to collect a sufficiency to fertilise their eggs. The lack of sperm may be due either to a shortage of males or to an incorrect timing of the spawning of the males in relation to the maturing of the females.

There is, however, no means of testing these views in this or a similar occurrence until further researches show at least how and when the native oyster stores the sperm destined to fertilise its ova. Hoek, the great Dutch naturalist, found and figured in 1883 (Tyd. Ned. Dierk. Ver, Supp. Deel 1, Leyden) discrete sperm in the renal tubules adjoining the external genital aperture in a female oyster, but the precise situation of this functional spermatheca has not yet been defined, nor has the condition of this region been determined in a significant number of ripening females to establish the facts of the normal method of fertilisation in O. edulis. A spermatheca which should contain enough sperm to fertilise any number of eggs from half a million to a million or more, in

oysters of 5 years of age or more, ought not to be difficult to demonstrate

An additional point of interest arising out of the observations recorded above is that owing to the large number of oysters which have spawned incompletely, it is probable that there will be a slightly increased mortality, and also an unusual number of shells with excretion blisters in the form of subspherical calcareous projection containing rejected ova, as some newly formed ones have already been seen From data which are being accumulated, evidence is being obtained that the incomplete spawning of females is a not uncommon cause of death, which will need to be considered carefully, in relation to occurrences of unusual mortality among ovsters. especially when such occurs in seasons of abnormal weather J H. ORTON

Marine Biological Laboratory, Plymouth, Aug 21.

#### Published Values of the Velocity of Light.

Some time ago, requiring a list of the determinations of the velocity of light made by different investigators, I, not unnaturally, referred to tables of this constant, some of those which were available to me being given by authorities of such ligh standing that their trustworthiness was, to my innocent mind, absolutely out of question

As a result, I found myself led astray to such an extent (amounting to the withdrawal, at the eleventh hour, of a paper already set up in type and about to appear in a well-known scientific publication) that I feel it incumbent upon me to ask the hospitality of the columns of NATURE to reveal the almost meredible confusion existing in most works of reference dealing with this particular question, as a warning to the unwary about to put their trust in second-hand information, instead of referring to the original papers themselves, and at the same time to put a plea before those on high who, being busy (and human, despite their exalted state), are inclined to quote from memory, initiating thereby errors which are copied and recopied indefinitely, until they mislead the investigators themselves who have made the experiments of which they so lightly misquote the results!

The discovery took place when I noticed extraordinary discrepancies between a table of the values of the velocity of light, given by Prot. A. A. Michelson in the Journal of the Franklin Institute for Nov. 1924, and reproduced in Nature for Dec 6, 1924 (p. 831), and Table 166 of the "Recuell de constantes physiques," by Abraham and Sacerdote, an imposing volume of 753 pages in 4to, published under the auspices of the Société Française de Physique. I beg leave to reproduce here the relevant portions of these two tables (for convenience's sake I have given a number to each of the determinations).

Journal of the Franklin Institute				"Recueil de constantes physiques"		
	Investi- gator	Distance km	Velocity		v (centa- mètres par seconde)	Auteurs
1 2	Cornu Perrotin	23 12	299,950 299,900	6 7		Fizeau, 1849 Cornu, 1871- 1874
3	Michelson Newcomb	0 6 6 5	299,895 299,860	8 9	2 9988 2 980	Perrotin, 1904 Foucault, 1819~1862
5	Michelson	35 4	299,820	10	2 9994	Michelson et Newcomb, 1885.
				11	2 9989	Michelson, 1902.

In order to dispel my perplexity, I had recourse to the original communications, memoirs, papers, etc, and to my amazement I found that of these 11 determinations, only one appears to be correctly quoted, or, at any rate, is in accordance with the

original contributions !

(1) Cornu's value is 300,400. The value 299,950 is evidently the result of a later discussion of Cornu's own results Apart from the fact that it appears questionable to quote as the result obtained by an investigator, a value to which he himself emphatically objected (Rapports présentés au Congrès International de Physique, 1900, vol 2, p 228), the value given is different from that given by Helmert (Astronomische Nachrichten, vol. 87, 1876–1878, p. 123) and from that of Listing as quoted everywhere else by Newcomb (Astronomical Papers for the American Ephemeris and Nautical Almanac, vol. 2. Pt. 111.). by Michelson himself (Decennial Publications of the University of Chicago, vol. 9, 1902, and Phil. Mag, 6th series, vol. 3, p. 334), and by others, namely, 299,990. I have not yet been able to find Listing's original paper and cannot offer any reason for the discrepancy.

(2) The distance given is that between the Nice Observatory and La Gaude, determinations over which gave 300,032. The value given (299,900) was obtained between the observatory and Mont Vinaigre, a distance of 45,950 7 metres, not 12 km. (Annales de

l'Observatoire de Nice, vol. 11, 1908)

(3) This value does not agree with any other value given in any contribution by Prof Michelson, the existence of which I have been able to ascertain corresponds closely to (11) (see below).

(4) The distance is wrong, this particular value was obtained between Fort Meyer and the Washington Monument, a distance of 3721 2 metres, not 65 km (loc. cit.)

(5) This value was correct at the time of publication. It has been since reduced to 299,802 (Astroph.

Jour., vol. 65, 1927, p. 2).

(6) Fizeau's result (for air) was given as 70,948 leagues of 25 to the degree. The "Nouveau Larousse Illustré," the standard French encyclopædia, gives 4444 inetres for the value of the "lieue de 25 au degré." This gives 315,300 nearly (Comptes rendus,

vol 29, 1849, p 90).

(7) Cornu's determination, as given, was obtained between Sept. 3 and 27, 1874. That obtained in 1871-1872, namely, 298,500, was altogether rejected (Annales de l'Observatoire de Paris, vol. 13, 1876).

(8) Perrotin's experiments giving this figure were made in 1902, not in 1904. It is only a preliminary result; the final value was 29990 (Annales de l'Observatoire de Nice, vol. 11, 1908).

(9) Foucault made no determination of the absolute velocity of light in 1849; all the work was done in the summer, 1862 (Comptes rendus, vol. 55, 1862, p.

(10) With the exception that Newcomb did not co-operate in these experiments, that they were performed in 1879, and that the result was 299,910, the data given are correct (Astronomical Papers for the American Ephemeris and Nautical Almanac, vol. 2,

(11) No determination appears to have been made by Michelson in 1902. The value 299,890 was adopted by him in a paper published that year, as representmg the best value up to that time, and is the average of several determinations by Cornu (discussed by Listing), Newcomb, and Michelson (Decennial Pub. Univ. Chicago, 1902, and Phil. Mag., 6th series, vol. 3, p. 334).

Nor is this all the tale: Newcomb (loc. cit.) states

that Cornu's first experiments were made in 1874, and his final ones in 1878, and this is repeated by Michelson, by Preston ("The Theory of Light" and by Cornu himselt (Rapports présentés au Congrès International de Physique, vol 2, p 227). Here is a physicist misled into giving a year four years in error for the time of his own experiments!

Finally, Michelson gives, as having been obtained in 1925 (Astroph Jour., vol 65, 1907, p 12, first line of the first table), a result, namely, 299,802, which had already been published in 1924 (loc. cit vol 60,

1924, p 256).

I shall not trouble readers of NATURE with the misprints which only offered a temporary check.

Some may think that I have been too exacting in respect of dates as they seem immaterial in the determination of a constant Let it be remembered that a velocity involves the use of a unit of time, and that so long as this unit is provided by the rotation of the terrestrial globe, it is apt to vary, and this variation cannot be ignored in measurements involving an incredibly small fraction of a second of time (one fifteen millionth in the case of Foucault). In few cases only is the actual date given in the original contributions from the investigators, the average time of the year has often to be guessed.

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#### Prof. Lewis's 'Light Corpuscles.'

In order to maintain his theory of light corpuscles (see Nature, Feb. 13. 1926), Prof G. N. Lewis has had to suppose that the absorption of a quantum, as an event, has a certain control over the emission of that quantum. This is repugnant to common sense, and remains so even when qualified in the way Prof. Lewis has been able to do.

To overcome this the following suggestion may be made. When two events are causally related, as, for example, the emission and absorption of a photon, it will depend upon certain conditions whether we can say that they are in causal contact; whether the

interval between them is zero.

When, on investigation, it is found that the two events are the only two concerned in the relation, then we must suppose that they are in causal contact, this is what is supposed to happen when light is transmitted in vacuo. But when on analysis it is found that there are other events concerned, then it is by no means necessary that the two events first mentioned should be in direct causal contact. Thus it may be that the events can be arranged in series by their extensional relations, with the two original events as ends or termini; and in this case, even though each event may be in contact with the next in the series, the two ends will not be so related: and, what is more, their mutual relations will depend upon the intervening events.

This simple suggestion will easily account for the observed diminution in the velocity of light in a refracting medium, and we may hope for an intelligible explanation of the diffraction effects of a lens system. Thus the absorption-event at the photographic plate is not directly related with the emissionevent at the distant star, nor is the interval between them zero; they are connected via the chain of events occurring within the lens system of the telescope, and these latter will presumably have an effect on the final absorption event, producing in fact the diffraction pattern that is observed.

M2

At first sight this idea upsets the simple reversibility of the process, but not, I think, if we confine the postulated reversibility to pairs of events actually in causal contact: in any case it is more intelligible and more in accordance with the historical development of physics than the one it has been designed to replace or supplement

WILLIAM BAND.

Physics Department, University of Liverpool, Aug. 18

#### Penetration of Radio Waves.

In a recent letter to NATURE (July 2) by two of the present writers, it was pointed out that information was lacking as to the extent to which radio waves could penetrate the earth By the courtesy of Mr. J. H. Clark, Mr. H. K. Lidstone, and other officials of the tamous Caribou Mine, Colorado, an opportunity was offered on Aug. 17 to make some satis-

factory tests on this point.

Mr. Guy L. Allen, of Boulder, used a nine-valve (or tube) super-heterodyne Victoreen set which he had built himself, and with which he had heard Buenos Ayres, Madrid, Lima, and London. At a depth of 220 feet below the surface, and in a cross cut clear of wire, rails, and pipes, he readily detected K F E L Denver (248 metres), and the concert was well heard from the loud speaker by all present. On proceeding to a depth of 550 feet, carrier-waves were detected, yet no clear reception was possible in the morning But in the evening at 9 20 the party returned to the 550-foot level, and at the end of a tortuous passage 80 feet distant from all wires and pipes, speech, music, and song from K O A Denver (326 metres) was heard from the loud speaker about as clearly as on the surface earlier in the evening. In both cases the reception was by loop, and in both cases maximum intensity was obtained when the loop pointed within a few degrees of Denver, about fifty miles away.

Previous experiments at the tunnel at Montreal, Canada, had shown that 40 metre waves were weak in penetrating power; that broadcasting waves were more efficient, while longer waves of 10,000 metres

surpassed both.

Details of this experiment will be published in due course in a report of the Bureau of Mines.

A. S EVE. D. A. KEYS E. H. DENNY.

Bureau of Mines, Washington, D C.

#### Pyrex as a Container for Radium Solution.1

Some readers of Nature may be interested to know that Pyrex glass is not suitable as a container for a solution of radium salt. About two and a half years ago, I dissolved salt containing 150 milligrams of radium and put it into a Pyrex bulb connected with a Toepler pump for removing the radion. Three months ago, when examining the bulb, I found it to be cracked in almost every conceivable direction. The bulb seemed airtight still, but the solution was mmediately removed to a soft glass bulb for safety. On closer examination it was found that the cracks started from the inner surface of the bulb. Some had

 $^{\rm 1}$  Publication authorised by the Director of the National Bureau of Standards of the U S. Department of Commerce

No. 3020, Vol. 1201

penetrated only slightly, and others were nearly or completely through to the outer surface. None extended below the level of the solution. They only

appeared where the radon could be expected to collect in quantity in the evacuated region just above the solution This indicates clearly that the cracks are caused by the bombardment of the inner surface by a-rays How this starts a crack, and causes it to continue only so far as the bombardment by the a-particles extends, is not readily understood This difficulty is not confined to a bulb containing solution, for I have also observed that Pyrex tubes used to store purified radon behave in a similar manner. It has been known for some years that quartz is affected similarly, a

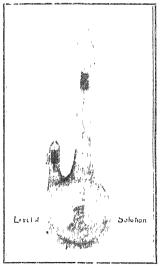


Fig 1 - Pviex bulb cracked by a-ray bombardment.

fact discovered, I believe, by Madame Curie. The accompanying photograph of the bulb (Fig. 1) shows many of the larger cracks.

L. F. Curtiss.

Bureau of Standards, Washington, D.C.

#### The Expert in the Civil Service.

Members of the professional, scientific, and technical classes in the Civil Service will welcome the leading article on "The Expert in the Civil Service" in the issue of Nature of Aug. 27. The proposal for the appointment of a Royal Commission to examine and report on the present position of the professional worker in State service has the full support of the Institution of Professional Civil Servants, a body representative of the above classes. Indeed, since its inception in 1919, the Institution has been striving to obtain an official inquiry into the conditions governing the employment of its members in the Civil Service. The Institution is convinced that the improvement of the status of professional workers in the Service—the necessary precedent to fuller economic recognition—and freer access to administrative posts, will only be obtained by such an inquiry as is advocated. An impartial inquiry into the position of the professional and scientific classes in State employment is absolutely essential if the efficiency and well-being of the Service under modern conditions are to be maintained. The Council of the Institution reiterated last year its policy of pressing for a public inquiry, and welcomes the influential support of NATURE in the steps that will be necessary to bring to pass this long-desired event, which is of such importance in the interests of both the State and the professional worker.

F. A A. MENZLER. (Honorary Secretary.)

The Institution of Professional Civil Servants, 69 Victoria Street, London, S.W.1, Aug. 29.

### Some Problems of Polar Geography.1

By Dr R N. RUDMOSE BROWN.

THE TASKS OF EXPLORATION.

THE existence of an Antarctic continent is still based on circumstantial evidence, and until more than some 5000 miles of its coastline, or only about 35 per cent. of the total length, are known, direct evidence of Antarctica will be lacking. It is not a little remarkable that all the exploration of the twentieth century has merely modified the probable outline of that continent as it was predicted by Sir John Murray in 1886. He had little but the reports of Ross, d'Urville, Wilkes, a few sealers, and the Challenger to go on, and, mainly on circumstantial evidence, he built his Antarctic The one considerable change in that continent map has been the curtailment of the Weddell Sea and the removal of its southern extremity some four degrees north of Murray's position in lat. 82° S

Most of the Antarctic 'lands,' and certainly nearly all those that may be classed as key positions to the coastline of Antarctica, date from last century, some of them from a hundred years ago Coats Land, Wilhelm Land, and Oates Land are among the few exceptions. Enderby Land, the one certain or nearly certain land in more than 3000 miles of hypothetical coastline, has never been seen or seriously searched for since Biscoe found it in 1831. It should be the base of an expedition that is prepared to work westwards. Heavy ice congestion so far found by all vessels that have tried to push south between Enderby Land and Coats Land, suggests that this stretch of coastline will have to be put in by sledge journeys along the edge of the ice cap. The western shores of the Weddell Sea are another ice-girt region which no ship has been able to penetrate, a region of dangerous ice pressure. Here, too, the advance must be by land journey, but it should be relatively simple, since accessible bases are known in Oscar Land and adjoining parts of Graham Land. Lastly, there is the great gap south of the Pacific between Charcot and Edward Lands, which leaves ample scope for an attack from both ends. A minor problem in the outline of Antarctica for an expedition based on Edward Land is the determination of the eastern side of the Ross Sea and the elucidation of Amundsen's sighting of land to the south of Edward Land, the appearance of land which he called Carmen Land.

Even more important, however, than the discovery of the 'missing' stretches of the Antarctic coastline is the explanation of the structure of the continent and its former connexions with other lands of the southern hemisphere

Graham Land and Victoria Land are both regions of lofty mountain ranges, but apparently of contrasted structure and diverse origin. The ranges of Graham Land, often called the Antarctic Andes,

<sup>1</sup> From the presidential address to Section E (Geography) of the British Association delivered at Leeds on Sept 1.

in stratigraphy and structure as well as in their eruptive rocks, bear so close a resemblance to the Cordilleras of South America that there can be no reasonable doubt that they were at one time connected and are in fact disunited parts of the same foldings Nor does it appear doubtful, any longer, that the line of former continuity can be traced by a submerged ridge on which stand relics of the chain in the South Orkneys, the volcanic South Sandwich Group and South Georgia, extending in a great arc between Trinity Land and Tierra del Fuego and sweeping well to the east of Drake There is no doubt of this line of connexion, but we are still uncertain if South Georgia, and even more so, if the Falklands are really fragments of the arc or relics of a lost South Atlantic Land.

The Antarctic Andes, or Southern Antilles, have been traced south-eastward but lost sight of at Alexander Island and Charcot Land, which in all probability are parts of the same formation. The great problem of the Antarctic is what happens to these ranges. On the opposite, or New Zealand, side of the Antarctic, the great fault ranges of Victoria Land show little if any resemblance in structure and origin to the Antarctic Andes. A great horst capped with horizontal layers of sandstone, probably of Permo-Carboniferous age, is associated with much evidence of volcanic activity, and seems to rise from a great peneplain of crystalline rocks which underlie the whole of that side of the Antarctic ice-sheet.

The structure of the Victoria Land edge of the Ross Sea is reminiscent of Tasmania and eastern Australia, and the suggestion of former continuity across the Southern Ocean receives further support from our knowledge of submarine relief between Antarctica and Australia.

The relationships between Antarctica and South Africa are still very obscure, since the African quadrant of the Antarctic, both by land and by sea, remains one of the least explored parts

One suggestion is that the horst of Victoria Land is continuous with the Antarctic Andes Certainly the direction of the Maud Mountains to the south of the Ross Sea supports this view, and evidence of great faults bounding the Andes may show that those ranges after all are not entirely different in nature from the ranges of Victoria Land. A second suggestion is that the Antarctic Andes reappear in the Ross Sea in the old crystalline rocks of King Edward Land—which as yet are but little known—and that these were once continuous with the folds of New Zealand. If this be true, the ranges of Victoria Land and the Maud Mountains probably swing across to Coats Land and may cause those vague shadowy shapes that a few of us who have seen Coats Land believe to exist in its far interior. Nothing is known at first hand of the structure of Coats Land, but rock fragments dredged in the Weddell Sea, and presumably

derived from Coats Land, suggest a closer relation with Victoria than with Graham Land

In any case, it looks probable that our knowledge of Antarctica confirms the growing belief that the Pacific basin is girdled by a ring of fold mountains marking the course of a system of geosynclines. The remains of the borderlands of this Pacific geosyncline may possibly be found in small islands in that mysterious ice-bound region to the north of Edward Land which no ship has been able to penetrate.

Much has yet to be done in explaining the peculiar Antarctic blizzards which rank among the flercest winds on the face of the globe. Dr G. C Simpson has given an explanation of these in the Ross Sea, but are the blizzards of Wilkes and Coats Lands, which occur under different topographical conditions, amenable to the same explanation, or has Prof. W. H. Hobbs found the solution in his theory of strophic winds associated with glacial anticyclones, a theory which he applies also to Greenland, where he is at present investigating it?

A further important meteorological problem, with strong geographical bearings, is the alimentation of the ice-sheet. We know that it is wasting by the calving of icebergs, by surface ablation, and other processes, and that it has shrunk considerably since its Pleistocene maximum, but we are at a loss to explain satisfactorily how the precipitation in the heart of an anticyclone can ever have been sufficient to allow such an ice-sheet to There is every reason to believe that during the great Ice Age, ice-sheets did not develop over the Arctic islands of Canada or over most of Siberia. The temperatures were low, but moisture was in-Yet in the southern hemisphere the sufficient ice grew in the heart of a vast high-pressure area

Still another problem is that of oscillation of climate as expressed by varying amounts of sea-ice and variations in the intensity of currents. R. C. Mossman and others have shown that there is a correlation between certain Antarctic records and those from places in the northern hemisphere. There seems to be every likelihood that before long general weather forecasts of real value will be possible for some months ahead. At Buenos Aires. for example, the high correlation coefficient of +0.88 is reached when the summer rainfall there is correlated with the temperature of the South Orkneys for the winter that began three and a half years earlier. In fact, statistical correlation indicates that a very cold winter at the South Orkneys will be followed after an interval of three and a half years by a drought over the Argentine cereal belt; a very mild winter, after the same interval of time, by bountiful rains.

Lastly, there is great need of oceanographical work in high southern latitudes. This branch of research has been overlooked by most expeditions in their hurry to reach their southern bases. The employment of echo-sounding should, however, make it both easier and more accurate.

No pioneer problems of equal magnitude await the explorer in north polar regions. There is small likelihood that any new land of importance remains to be discovered. There is certainly no 'polar continent.' However, there are gaps to be filled Nicholas Land, found by the Russians to the north of the Taimir pennsula in 1913, has still to be investigated. Its full extent and its relation to other Arctic islands are unknown. North-west of it the Arctic Ocean has never been penetrated except by the drifting St. Anna in 1912–14. We hope that Russian investigators of the coast of Siberia will include Nicholas Land within their scope of work.

Another problem of importance and far-reaching influence is the mysterious fluctuation in the extent of Arctic sea-ice. The fluctuations appear to be cyclic rather than progressive, but so far defy satisfactory explanation. Dr. C. E. P. Brooks has recently pointed out the influence of the amount of ice in the Labrador and East Greenland currents on pressure distribution and consequent amount of precipitation in the British Isles. Here at least is one direct link between the Arctic and the most important factor in our climate. But until we know more about Arctic climatic conditions and the distribution of ice in the Arctic basin, we are not likely to find the cause of these fluctuations.

Facts so far available point to a rotary surface movement with overflows from an overcharged Arctic basin, by the Greenland Sea and other less important outlets. This movement may account for the tendency of ice-bound vessels in the Arctic basin to take a peripheral drift. It may also explain the relatively smooth and unrafted ice reported from the vicinity of the Pole. Again, the heavy ice to the north of Greenland may be due simply to the heaping and rafting against the land of the pack that has been swept past the overflow of the East Greenland current. It cannot, however, be said that this circulation is proved.

Fluctuations in the amount of ice in the overflow currents may well be due to variations in the strength of these currents. These variations may be associated with departures from the normal in the amount of water poured into the Arctic basin from the great Siberian and American rivers, which in its turn depends on causes far removed from Arctic regions. The complexity of the problem is almost baffling, but even before the chain of cause and effect is traced, useful work could be done in looking for correlations.

#### METHODS OF EXPLORATION.

In recent years the aeroplane has appeared in the Arctic, and Amundsen and Nobile have used the airship. It was inevitable that aviation should be tried in high latitudes, if for no other reason than its spectacular daring, but so far its success has not been marked. That, however, does not necessarily imply that aviation is never to be a serious help in polar exploration. Amundsen's flight in the Norge gave a probable confirmation of what had already been deduced from indirect evidence. He found no land where none was expected. He saw nothing but ice-covered sea. Moreover, a rapid flight over snow-covered land, even if the eye could distinguish that surface from ice-covered sea, would tell little

of importance Byrd's flight to the Pole and back was of even less value to exploration, for on his track there was no possibility of land. The kind of exploration that is now required entails patient observation and accurate measurement. A quickmoving machine cannot help in this, and there is always the probability of mist to hamper the value and imperil the success of aviation in the polar summer. Amundsen himself admits that owing to "a tremendous sea of fog, in some places of extraordinary density" in the Beaufort Sea, he may have passed over islands of low altitude without seeing them. So that on the only part of its course where land can possibly exist, the flight of the Norge has left us where we were, and the field is clear for the next explorer.

Even for reconnaissance the aeroplane has doubtful value. So much depends on ground organisation, which never can be perfect in polar regions, and there is the even greater difficulty of satisfactory landing-places. In one respect, however, the aeroplane can be successfully used in polar work, that is in aerial survey of difficult country that hes within reach of a base accessible by sea transport and provided with a good landing-place. In the Antarctic, where I have pointed out the pioneer explorer still has ample scope, long-distance flights may be of some value. The ice-cap offers the prospect of better landing than the pack-ice. Yet in view of its great expanse there is even less chance of retreating on foot after a forced descent.

#### SETTLEMENT OF POLAR LANDS.

During recent years, territorial claims have been made to all parts of Arctic regions that were not formerly subject to sovereignty, and even in the Antarctic great dependencies have appeared. This is an expression of the growing belief that polar regions are not merely desert wastes but have some economic resources of value to man.

There is no reason to suppose that the domestication of reindeer, starting with Siberian stock and gradually introducing the American caribou, will be anything but successful in most parts of the Canadian tundra, in the rich pasture lands of western Greenland, and the more restricted areas of Spitsbergen. All these regions have supported vast numbers of reindeer in the past, and should do so again if excessive hunting is curbed, wise game laws instituted, and the wolf exterminated, as Canada is endeavouring to do.

Alaska is said to have pasturage for 4,000,000 remdeer. Basing his estimate on this figure, Stefansson calculates that the Arctic tundras as a whole are capable of supporting about 100,000,000 reindeer and perhaps five times as many musk-ox. This is probably an over-sanguine estimate, for it must be remembered that the Alaskan herds are mainly in the more fertile valleys of the south and south-west, which have few, if any, equals in fertility in the tundras farther north; but even if we reduce the numbers considerably, say by so much as 50 per cent., there remains a possible food production from the waste Arctic lands equivalent to some 1,000,000,000 sheep, or more than ten

times the total number of sheep that Australia now supports

This would, of course, take many years to accomplish, and naturally will not occur until the temperate lands of the world are more fully occupied than at present But gradually as world population multiplies and food production has to be increased, the lands that are not fit for cereal growth will command attention by their possibilities for It is a geographical axiom that the pasturage herder must always give way to the tiller of the soil with his more intensive occupation With the extension of dry farming, there seems little likelihood of any considerable areas of temperate lands in the long run being left to pastoral pursuits. But the Arctic tundras are entirely unsuited for agriculture by unfitness of soil and shortness of summer for ripening the grain. Their advantage as pasture land is that the farmer can never displace the herdsman As the world's supply of beef decreases, the supply of venison and musk-ox flesh will come more into demand

Up to the present, the tide of human migration has flowed and ebbed on Arctic shores and has been mainly a seasonal movement, marked even in the permanent residents by a great degree of nomadism But eventually the tide of white settlement will definitely set northward, even to the Arctic seas, and in its flood destroy the present inhabitants.

It is no more presumptuous to forecast a scattered population of reindeer and musk-ox farmers in the 'barren lands' of Arctic Canada, the tundras of Siberia, and even in Greenland and Spitsbergen too, a hundred years hence, than it was a hundred years ago to suggest sheep farmers in the plains of Australia or wheat fields in the Peace Valley of Canada. Every land beyond the frontiers of settlement has been a 'never-never land' to unadventurous and unimaginative folk living in sheltered homes. But in most cases the prediction has been falsified.

The problem is one of considerable importance in the future of human settlement for two reasons. First, because there is no real evidence that the white races are suited for the tropics; that is to say, for permanent racial transference as apart from visits. All the evidence that is conclusive points the other way and suggests that only by a slow process of natural selection can the white races ever find a sure footing in the tropics. Long before that is achieved, the coloured races will have effectively occupied the warm lands. This means that the white races must turn, as in effect they have been turning for several centuries, polewards in their search for new homes. Secondly, the possibility of polar settlements affects, as I have tried to show, the future food production of vast areas which at present enter little into the economic life of the crowded populations of food-importing communities.

The only example of real Arctic colonisation that exists is that of the old Norse colonies in southwestern Greenland founded in the tenth century. At their height the two colonies must have contained between 2000 and 3000 people, men, women,

and children, scattered in about 280 farms, where they kept cattle, goats, sheep, and horses, perhaps raised a few poor crops of little account, and hunted bears, reindeer, and seals. There is no need to recall the history of these settlements, how trade with Europe gradually ceased and how the Norsemen had entirely disappeared when late in the sixteenth century communications with Greenland were reopened.

Recent Danish researches at Herjolfsnes, near Cape Farewell, have discredited the old belief that the colonies disappeared either by Eskimo extermination or by fusion with the Eskimo races seems clear, at least as regards Oesterbygd, that the Norse race maintained its racial purity and did not go native' The general reluctance of the Nordic races to mix with widely divergent stock was as noticeable then as it has been in later centuries Examination of skeletons in the churchyard of Herjolfsnes reveals the interesting facts that while clothes and ornaments, in graves of the fifteenth century, show little trace of Eskimo influence, the skeletons all show signs of rickets or other malformations and stunted growth, but no sign of racial mixture with the Eskimo. There is also a very high proportion of remains of infants and young people. Evidently, therefore, the Norse colonies, at least Oesterbygd, perished by exhaustion. Even if the climate were changing for the worst during the existence of these coloniesand such a change is by no means proved—there is no reason to suppose that the habitual meat diet failed. The cessation of communications with Europe cannot have affected the diet of the colonists to any great extent. The King's Mirror, describing conditions when the colonies were prosperous, notes that most of the settlers did not know what bread was. And what else could they get from Europe to vary their meat diet?

The conclusion is, therefore, that the Norse colonists in Greenland died out for want of new blood, or, in other words, that they were not acclimatised to their Arctic home. From this it might be argued that even the Nordics can never colonise the Arctic. Certainly no other race from

temperate climates is likely to try, since the Nordies alone show that distaste for gregariousness and that capacity for enduring solitude which are essential qualities for the task. We may even grant them a greater measure of physical enterprise and love of wandering than other people

The Greenland experiment is not, however, a sure criterion of Nordic unsuitability for the Arctic. The pastoral settlement, which is suggested, will be a slow colonisation, in which natural selection will have some say. Those suited will remain, others But the colonists will will move away or perish not be cut off from the world . they will be in close touch with it. New blood will continually flow in their veins, so that the unchecked course of natural selection which operated in the old isolated Norse colonies and killed out the more nervous and imaginative type, a type that is least adapted to the Arctic, will not have free play. There is no reason why the race should become impoverished by the elimination of its most progressive element Even though a diet solely of meat has proved wholesome enough in the case of Eskimo and some explorers, it will not be necessary for the Arctic colonists to subsist on it entirely: transport facilities will bring every variety of food to their doors. If the Norsemen suffered from insufficiency of certain ingredients in their diet, a sımılar fate will not be the lot of the colonists of the future If they died out by lack of new blood and continual inbreeding, the Arctic settlers of the future will be able to avoid that disaster.

Such is the legitimate forecast, as I see it, of the outer rim of the Arctic of the future with its prosperous, though scattered, colonists of pastoral interests, and its fur farms here and there supplying high-priced Arctic furs in limited numbers. But the settlement must wait until the pressure of population on the world's resources is even greater than it is to-day. The remoter parts, those without rich tundra and the ice-covered seas and lands, must remain deserts, visited only by roving hunters and occasional explorers. In short, I see a shrinking of the Arctic wildernesses, but never their disappearance.

# The Structure of Silicates. By Prof. W. L. Bragg, F.R.S.

AT a time when the fundamental conceptions of the structure of matter are being changed so rapidly, when every six months witnesses the birth of a new analytical method of dealing with the very foundations of our physical science, the study of the crystal patterns of silicates must seem a trivial matter. Yet similar studies have played their part in the extraordinary development of physics in the last decade, and I hope that the refinement of our methods of analysis, such as is represented by the present examples, will in turn prove to be of use.

The results of the particular investigations which I propose to describe are interesting in themselves

Discourse delivered at the Royal Institution on Friday, May 20.

because the silicates form so large a proportion of the earth's solid crust, and certain artificial forms are so largely used for technical purposes. I think, however, that it is right to stress another aspect of this study. We are trying to improve the technique of the X-ray examination of solid bodies, to increase the resolving power of our instruments so that we can see finer detail and deal with more complicated structures. It is at present a tedious and difficult task to discover how the atoms are arranged in these bodies; even when some experience in handling them has been obtained, one has to devote much time and concentration to each particular case. Yet every solution makes the next problem easier to attack, and when we look

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back on the last few years' progress, I think a very real increase in power of analysis is evident as the result of the efforts of many workers in this field.

It is this advancement of technique in which, personally, I am particularly interested. In trying to improve our instrument we examine with it from time to time a new type of solid body—these silicates being an example—and we describe what we see. I am not competent to discuss the discoveries we make; I can only hope that the casting of light at a new angle may be useful to those who have made a life-long study of these particular types of compound—I feel that my main contribution must be a demonstration of what knowledge it is possible to attain by careful X-ray examination.

The silicates present a highly interesting series of problems for X-ray analysis. The numerous crystalline forms have been carefully studied because of their importance to the mineralogist, and they show most interesting relationships and wide variation in composition. It is estimated that oxygen, silicon, aluminium, and iron by themselves compose about 87 per cent. of the earth's crust, and if we add four other elements, calcium, sodium, potassium, and magnesium, they amount together to 98 per cent. These are the elements that build up the compounds we are considering, and their relative proportions are a reflection of the fact that most of the earth's crust is composed of compounds of metals with silicon and oxygen.

The silicates occur as solid bodies, the atoms of which are arranged in crystalline patterns. These patterns are often very complex, and it would be difficult to attack them by general methods unless some guiding line could be followed through the intricate maze. Such a guiding line may perhaps be found in the peculiar part which the oxygen atoms play in building up the structure. Not only are the oxygen atoms the most numerous, but also they appear to be the most bulky of the units of which the pattern is woven, so that their predominant size and number make them force the other atoms to conform to certain simple and characteristic arrangements of oxygen atoms which we find occurring again and again as an underlying motif, throughout the range of such silicates as have yet been analysed. A few simple examples may help to illustrate this point

Four spheres, packed together as tightly as possible, assume a tetrahedral arrangement with one sphere standing on three others (Fig 1a). Six spheres when packed together take up a form where three of them lie on top of three others (Fig. 1b). Alternatively we may regard this arrangement as four spheres at corners of a square, with one above and one below this square (Fig. 1c), the second arrangement being identical with the first regarded from a different view point.

These very simple groupings of oxygen atoms, with an atom of some other element at the centre of the group, occur again and again in the silicates and in many other compounds. In many cases the group not only has a characteristic shape, but also a characteristic size, the distance between the

oxygen atoms having a value of about 2.5 Å.U. to

2 7 A U. In the list of common elements given above it is only sodium, calcium, and potassium which appear to break up the regularity of this group, and to force the oxygen atoms apart if placed at the group centre. The other elements appear to fit comfortably into the interstices of the oxygen grouping. Since there is a common distance throughout between oxygen atoms, certain atoms of one group can at the same time form part of the next group, and so a continuous structure is built up which may be thought of as a pattern of oxygen atoms with the metal and silicon atoms in its interstices

This predominance of the oxygen atoms greatly simplifies the analysis of the structures, and makes it easier to visualise the relationships between

different types All these bodies build up a crystalline pattern repeated again and again to space. Now the simplest types of pattern are those such as children are taught to make, when blocks of the same shape and size, but coloured differently, can be stacked together in geometrical designs The silicates present rather a fascinating analogy to these kindergarten patterns, the oxygen atoms being the

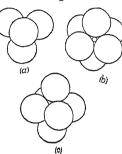


Fig 1—Groups of four, and of six, oxygen atoms Such groups, with atoms of silicon or one of the metals at the centre, are repeated indefnitely in the silicate structure

blocks and the other atoms the colouring agent. It is as if a complex pattern were embroidered by the other atoms upon a simple underlying fabric of oxygen atoms.

The two types of group, four-fold and six-fold, illustrated in Fig 1 are composed of oxygen atoms equidistant from their neighbours. We have seen that they may be regarded as spheres compressed into the smallest possible space. Such an arrangement can be continued indefinitely, and if it is done regularly one or other of two characteristic groupings of spheres is the result. These are the well-known forms of cubic and hexagonal close-packing.

This close-packing of the oxygen atoms is a very simple arrangement, and it is interesting to find that a number of silicates are based on it. Its existence in a silicate can be surmised by noting how much volume there is to each oxygen atom in the whole structure. If the oxygen atoms are packed together closely, with 2.7 Å U. between their centres, it is easy to calculate that each atom occupies a minimum volume of 14 (Å U.3). (If magnesium and iron are present, they expand this volume slightly by an amount for which allowance can be made.) Further, the refractive index, if ideal close-packing exists, must not be less than 1.7, as the oxygen atoms have a high refractivity.

Using these tests, it appears probable that certain compounds are based on one of the forms of close-packing, and we have examined some of these cases. The close-packing of the oxygen atoms is, however, exceptional, and although in most compounds the

fourfold and sixfold groups form the basis of the pattern, this pattern may be of an open type. The various forms of silica, to the investigation of which the Royal Institution has made so large a contribution, are beautiful examples of open patterns built of the four-fold groups, and other examples of these lace-work open patterns have been analysed. The closely woven patterns have been chosen for de-

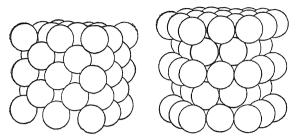


Fig 2 -Spheres in cubic and hexagonal closest-packing

scription here because their basis is the more simple.

In order to understand these frameworks of oxygen atoms, with metal atoms packed in the interstices, it is necessary to bear in mind some of the geometrical laws of pattern-making. If a repeated pattern be formed by stacking together blocks of the same size and shape, but different in colour, the unit of the pattern will be composed of a whole number of blocks. It is always possible to outline the pattern with a series of unit cells, each of which just contains one complete example of

the pattern and no more. The unit cell may be a large and distorted one if the pattern is complex, but it must always obey one condition. If one corner is placed at the centre of a block, all the other corners will also be at centres. The crystals which are based on one of the close-packed arrangements of oxygen atoms must have a unit cell related to the close-packed arrangement in this way.

Disthene or cyanite, Al<sub>2</sub>SiO<sub>5</sub>, is an example of such a crystal. Its unit cell could not well be more irregular. Its edges, and the angles between them, are all unequal, as shown in Fig. 3.

Yet its high refractive index (1.72) and small volume per oxygen atom (15.0 Å.U.3) hint that the oxygen atoms are in one of the forms of close-packing. An X-ray examination has proved this to be the case. The packing turns out to be of the cubic type, and the way the disthene cell and the cubically arranged oxygen atoms 'fit together' is shown in Fig. 3. The cell of disthene contains twenty oxygen atoms, and the cell outlined in the right-hand figure contains exactly twenty close-packed spheres. This very complex pattern of disthene has to be woven into a basis of twenty

oxygen atoms, since a multiple of five is demanded by the chemical formula. The irregular disthene cell is the way chosen by Nature of blocking out suitable groups of twenty oxygen atoms from the very simple cubic structure

When the scattering of X-rays by the crystal is examined, the close-packed arrangement of oxygen atoms shows up strongly. We can consider the effect on the X-rays as composed of that due to the oxygen atoms on one hand, combined with that due to the atoms of metal and silicon on the other hand. The former leads to a simple and intense diffraction pattern, to be expected from a straightforward cubic face-centred lattice. The aluminium and silicon atoms, which form a complex embroidery on a large scale woven into the oxygens, give a complex diffraction pattern within that due to the oxygen atoms alone. Fig. 4 illustrates the point.

The complex inner pattern contains the information necessary to tell us where the aluminum and silicon atoms are. It is a difficult matter to unravel its story, but it is by no means so formulable as it would have been had we not known that the oxygen atoms are nearly in this simple arrangement, and that the aluminum and silicon atoms are somewhere within the four-fold or six-fold groups of oxygen atoms.

As another example of this pattern-weaving, the series of compounds Mg<sub>2</sub>SiO<sub>4</sub>, MgO<sub>2</sub>H<sub>2</sub> (Mg<sub>2</sub>SiO<sub>4</sub>)<sub>2</sub>, MgO<sub>2</sub>H<sub>2</sub> (Mg<sub>2</sub>SiO<sub>4</sub>)<sub>2</sub>, MgO<sub>2</sub>H<sub>2</sub> (Mg<sub>2</sub>SiO<sub>4</sub>)<sub>4</sub> may be examined. The dimensional relationships between these crystals (the chondrodite series) have long

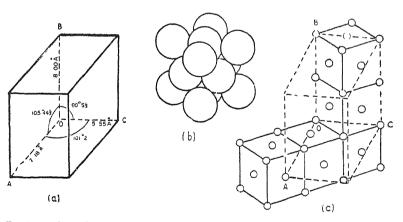


Fig. 3—(a) shows the unit cell of disthene; (b) is a portion of the array of spheres in cubic close-packing, (c) shows to the same scale a more extended portion of this array, the centres of the spheres alone being indicated. The unit cell of disthene is also a unit cell (containing twenty points) of the cubic lattice, thus is proved by the way in which OA, OB, OC correspond in length and direction in (a) and (c).

aroused interest. If we measure the unit cells of the compounds we find that two axes, outlining one face, remain constant throughout all four crystals. The thickness of the cell measured perpendicularly to this face increases in regular steps in the last three compounds, as if blocks of magnesium silicate were being added on in a regular way. With the aid of X-rays this process can be followed out in detail, and some finer points of it are not without interest. All the compounds prove to be based on hexagonal close-packing, and with

the aid of this guiding feature, Mr West and Mr. Taylor, who have been working on these crystals in my laboratory, have, in my opinion, succeeded in elucidating the approximate positions of all the

Fig. 4 —Rotation photograph around b axis of distince (right) compared with ideal rotation photograph around cube edge for close-packed atoms (left)

atoms in these complex patterns. Their results are shown in Fig. 5

These patterns are very formidable unless one has made a special study of them. However, the figures may perhaps make clear the main points We have to explain the way in which the unit cell varies in size from compound to compound, and we have also to explain a curious complication Whereas  $Mg_2S_1O_1$  and  $MgO_2H_2$ (Mg<sub>2</sub>S<sub>1</sub>O<sub>1</sub>)<sub>3</sub> have a rectangular cell (orthorhombic), the other two compounds are built on a slant with the type of symmetry called monoclinic. The blocks are not clapped directly on top of each other, but are stepped sideways It is fascinating (to the enthusiast) to see how naturally the results follow from the arrangements shown in the figure.

The circles in Fig 5 represent the oxygen atoms which form the framework on which our whole structure is based Two layers of such atoms are shown, representing two sheets of spheres packed closely, one lying on the other Some of the oxygen atoms are linked together to form a group SiO<sub>4</sub> with a silicon (not shown) at its centre. These groups are shown as tetrahedra in the diagram, and six or three edges of each tetrahedron are drawn, depending on whether its apex is turned towards or away

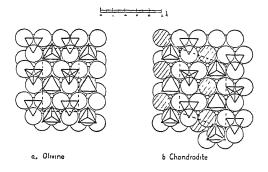
from the observer. The magnesium atoms are left out of the diagram for the sake of simplicity; the shaded pairs of oxygen atoms are to be labelled 'OH,' since they must belong to the hydroxyl groups.

Each crystal is a series of alternate strata of magnesium silicate and magnesium hydroxide.

That part of it which is magnesium silicate is arranged exactly like the pure magnesium silicate shown in Fig. 5a The layers of hydroxide cement together the blocks of magnesium silicate. In

order to outline the unit cell of any of these patterns, we join up four points in the pattern which are exactly alike. The diagram will show that the measured unit cells, shown by dotted lines, are exactly those cells which satisfy these conditions Chondrodite, MgO<sub>2</sub>H<sub>2</sub> (Mg<sub>2</sub>SiO<sub>4</sub>)<sub>2</sub>, must have a slanting cell, the next compound, humite, a long rectangular one, and the last, clinohumite, again a slanting cell. We were surprised in making our X-ray examination to find such a curious difference

in the shape of the unit cell between humite on one hand and chondrodite and chondumite on the other hand. When the pattern was put together, however, it was clear that such a difference



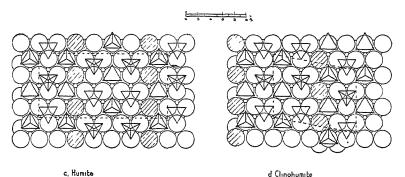


FIG 5 — Atomic arrangement of the chondrodite series of minerals (after Taylor and West). Two layers of oxygen atoms in hexagonal close-packing are shown, projected on the plane (100) of each crystal The a axes of the crystals are perpendicular to the plane of the diagram, and are practically identical for all the crystals. The diagram shows the identity of the vertical b axis in all the crystals, and the relationships in direction and length between the c axes.

followed naturally from the relative numbers of silicate and hydroxide strata.

Though very few examples of silicates have yet been analysed, the temptation to draw conclusions from them is irresistible. The most curious feature about the natural silicates is the immense variety in composition which occurs within one and the same mineral species Stupendous chemical formulæ have to be assigned in order to explain even approximately the relative proportions of the different elements in some well-known

It seems to me that the position becomes clearer when we consider the compounds as an embroidery of the metal atoms upon an oxygen framework. We may compare the oxygen framework to the steel girder system of a large ferro-concrete building in course of construction, which is intended to be divided into sets of flats Before the girder system is filled in, its configuration is very simple indeed Then certain blocks of it are partitioned off into sets of rooms, each comprising a flat; these flats are the more complex units of pattern in the crystalline structure. The arrangement of the rooms in each flat corresponds to the selection in our oxygen framework of certain spaces in which to put the metal atoms We can go one step further, and rent our flats to families of slightly different composition, so that a census of the whole building shows a bewildering proportion of types of inhabitants difficult to represent by a definite family formula. This is really the state of affairs with which the chemist is confronted when he attempts to give a formula to many of the silicates

Some of the very earliest structures which were analysed caused us to revise our ideas of what was meant by the 'molecule' of the chemist In sodium chloride there appear to be no molecules represented by NaCl The equality in numbers of sodium and chlorine atoms is arrived at by a chessboard pattern of these atoms; it is a result of geometry and not of a pairing-off of the atoms This is, of course, not universally true, for this absence of the molecule in solids is in general only found in inorganic compounds. It would appear, however, that the silicates are of this non-molecular type, and that in seeking to assign formulæ to them, and to the hypothetical acids of silicon on which they are based, it should be borne in mind that they are really extended patterns. The relative numbers of their constituent atoms are characteristic of the extended pattern, and essentially a result of their solid state, so that it is doubtful whether a grouping of the atoms into molecules has in this case a meaning. It will be very interesting to see what further light the X-ray results can cast on the relationships in this fascinating series of compounds.

#### Obituary.

PROF. RUDOLF MAGNUS.

THROUGH the sudden and untimely death, at the age of fifty-three years, of Rudolf Magnus, professor of pharmacology in the University of Utrecht, the world of science loses one who had for some years past been one of the outstanding figures in experimental medicine. At this moment there is nearing completion in Utrecht, and to be opened this autumn, a fine new Institute of Pharmacology, given by the Rockefeller Foundation with the primary object of widening the opportunity for and increasing the influence of his investigations. These, for some eighteen years past, have issued in an imposing series from the picturesque laboratory which Magnus had evolved, with great ingenuity, from a small monastic plague-hospital. The many who knew and admired him had thought of him carrying on his brilliant work for at least two further decades, and touching a growing circle with his ideas and his enthusiasm, under material conditions at last worthy of his genius.

Magnus is most widely known for the work which he, with a brilliant group of collaborators, has carried out during the past eighteen years on the functions of the central nervous system, and, in particular, on the reflex mechanisms involved in the assumption and maintenance of bodily posture, in normal relation to the earth's surface. He had spent several periods in British laboratories, with Schafer in Edinburgh, with Langley in Cambridge, and with Sherrington in Liverpool. From the last-mentioned association he received the stimulus which resulted in this best known and most important phase of his work. In Utrecht he had invaluable co-operation in this line of investigation from De Kleijn, Raademaker, and others; Dr. de Kleijn has won eminence as an otological surgeon without relinquishing his position as assistant in Magnus's department of pharmacology. The results of this work have appeared in a long series of papers, and have been embodied by Magnus in a masterly monograph on "Korperstellung," published in 1925. In the same year he gave a brilliant summary of the work in the Crooman Lecture to

the Royal Society.

This work on the central nervous system, which attracted physiologists and neurologists from all over the world to Utrecht, represents, however, only one side of Magnus's scientific activity Before his appointment to the Utrecht chair, he had been for a long term of years attached to the department of pharmacology at Heidelberg under Gottlieb. During this period he published a series of important papers of a more definitely pharmacological interest. Among the items of this earlier work may be mentioned his introduction of the method of studying the activity of mammalian unstriated muscle, by the simple technique of suspending the organ containing it in warm, oxygenated Locke-Ringer solution. Magnus, unlike some of the many who have since used it, always had clearly in view the true value and limitations of the method, and even in recent years his pupils were still busy with its application to isolated layers of the intestinal wall, with results leading to revision of his earlier conclusions as to the neurogenous nature of intestinal rhythm. By the use of this method also, in the Utrecht period, he and his pupils reached important conclusions concerning the significance of choline as a natural hormone of intestinal activity

It is an astonishing fact, indeed, that Magnus made his Institute a centre of world interest in experimental neurology, without relaxing his activity or his interest in ordinary pharmacology, He delivered his regular course on pharmacology, in a language newly acquired in middle life, served as a member of the commission for revising the Dutch pharmacopæia, and was one of the most active members of the two International Conferences on Biological Standards. In connexion with the latter he supervised important investigations on the standardisation of pituitary extract and digitalis, and made himself responsible for preparing the international standard sample of the latter. His laboratory, quite apart from its achievements in neurology, maintained a steady output of good pharmacological work. There he on my table, at the time of writing, lectures on "The Experimental Pharmacology of the Lungs" and on Cholme as an Intestinal Hormone" These were two of the five which he had written for delivery in America on a visit projected for next year, and he had sent them to me for a final retouching, scarcely needed, of their English idiom Presumably he had pressed himself too hard, but he left in good spirits for a holiday in Pontresma, where he died in his sleep after a day of active enjoyment.

Magnus was born in Brunswick, and, though domiciled since 1909 in Holland as a loyal and enthusiastic professor in Utrecht, he retained his German nationality and sympathies During the War he returned to Germany for some years to conduct and organise research on defensive measures in chemical warfare His strong national sentiment in no degree weakened his personal attachment to British colleagues, and he eagerly resumed the relations with British physiologists which had meant so much to him and to them, and had led them to regard him almost as one of their own community He came as a welcome guest this spring to the fiftieth anniversary celebration of the Physiological Society, and was a candidate for election to its ordinary membership. Medical science has lost a great investigator, still in his prime, and a genial and inspiring personality.

H. H. D.

#### MR. G. C. CHAMPION.

The death of George Charles Champion, coleopterist, on Aug. 8 at Horsell, Surrey, removes from the ranks of British entomologists one whose name has been a household word among them for more than half a century.

George Charles Champion, who was born in South London in 1851, began to collect and study beetles as a schoolboy, and before he was twenty years old he was recognised by the foremost coleopterists of that time as a field entomologist of more than ordinary energy and acumen A large number of species were added by him to the British fauna previous to 1878, in which year he was offered a commission by the late F. DuCane Godman and Osbert Salvin to proceed to Central America and collect entomological material for the great faunistic work which they had recently commenced. Champion arrived in Guatemala early in 1879, and during the next two years traversed

many hundreds of miles on horse- and mule-back, from the Pacific coast to the Polochic Valley opening into the Caribbean Sea— The number of insects of all orders collected by him and sent home in first-rate condition from Guatemala was truly enormous, and even greater success attended his researches in Chiriqui, Colombia, where his last two years in Central America were spent—An admirable itinerary of his travels in this region appeared in the *Entomological News* for 1907, which is reproduced with additions in the introductory volume of the 'Biologia Centrali-Americana'"

Champion returned to England in 1883, and at once found congenial work as sub-editor of the "Biologia," and private secretary to Messis Godman and Salvin Besides preparing, with the able assistance of the late Mr Arthur Cant, the vast mass of Central American Coleoptera for the collaborators in the section of the great work devoted to the Insecta, he was entirely or mainly responsible for eight volumes dealing with that order, in which upwards of 4000 species of beetles were described by him as new. Another volume on the Rhynchota is also due to him, and his share in the production of the "Biologia" is generously acknowledged by the late Dr Godman in the "Introductory Volume," which concluded the great undertaking in 1915.

Champion's favourite group of beetles was the Heteromera, and in 1895 he published in the Belgian *Annales* a list of the Tenebrionidæ supplementary to that of the great Munich Catalogue of 1869, which more than doubled the number of known species of that extensive family.

The name of Champion is especially associated with the *Entomologist's Monthly Magazine*. To the pages of this valuable serial he was one of the earliest and most constant contributors, and after he became a member of the editorial staff in 1891, his services in maintaining the high standard and character of the magazine have throughout been regarded by his colleagues as inestimable. He was also, for the last four years, one of the editors of the *Annals and Magazine of Natural History*.

In 1891, twenty years after his election as a subscriber, Champion succeeded the late Ferdinand Grut as librarian to the Entomological Society of London. He held this onerous office for nearly thirty years, and in 1893 he produced the first printed "Catalogue" of the Library, followed by a "Supplement" seven years afterwards His modest and retiring character prevented his acceptance of the chair of the Society, but in 1925 he was one of the vice-presidents. He joined the Zoological Society in 1888, and in 1897 the Linnean Society elected him one of its associates jubilee meeting of the South London Entomological Society in 1922, he was the sole surviving original member, having taken a leading share in the inception of this flourishing association Steady, thorough, and meticulously accurate in all his work, and at all times ready to assist his friends and colleagues to the utmost of his power, his death leaves a gap in the ranks of British entomologists which it will be difficult to fill

#### News and Views.

Comments have recently appeared in the piess on the possibility of a connexion between the total solar eclipse of June 29 and the unusually wet weather during this summer in Great Britain. It may, of course, be said at once that there is no scientific basis for the theory that the eclipse is responsible for the wet summer It is impossible to disprove absolutely the theory, because we cannot make the experiment of having the year 1927 over again, but without an eclipse visible in England. It is, however, possible to give sufficient reasons to indicate the improbability of any connexion between the eclipse and the persistent wet weather. In the first place there are at least two solar eclipses every year and there are no corresponding wet periods in Britain m fact. during the period 1881-1925, when there were 25 important total eclipses, the rainfall of the Butish Isles for each of the 6 months beginning with the month of eclipse was above the average in 63 cases, below the average in 83 cases, and equal to the average in 4 cases. In the month of the eclipse the rainfall was below the average in 16 cases, and above the average in 7, and equal to the average in 2, in the month following the eclipse month, rainfall was below the average in 12 and above the average in 13: in the succeeding month, i.e. the second month after the eclipse month, rainfall was below the average in 14 and above the average in 11. The effect of an ecluse, if it existed, could not therefore be of a general character, due to the earth's atmosphere being temporarily deprived of a portion of the solar radiation or emanation which it normally received.

It has sometimes been suggested that there is a purely local connexion with weather confined to the part of the earth's surface where the eclipse occurs, due to that area being temporarily deprived of solar radiation. But the area is temporarily deprived of solar radiation every night for a much longer period than that involved in an eclipse; and if an eclipse produced wet weather, night ought to produce much wetter weather. There is no evidence of any such effect. The wettest years in Britain in the period covered by trustworthy general rainfall statistics have been 1872, 1879, 1903, and 1912: the three former years were not years of eclipse in Britain, while in the latter year a partial (nearly total) eclipse was visible. The driest years have been 1870, 1887, 1893, and 1921. The three earlier years were not years of eclipse in Britain, but in 1921 there was an annular eclipse. If the references to the weather of eclipse years in Britain are examined for the period before regular statistics were collected, it is found that they vary · some eclipse years were wet, some dry. In 764, when an annular eclipse occurred in June, the year is stated to have been one of drought after long and severe frost. In 1191, again a year of annular eclipse in June, the year is recorded as a year of famine. Mr. R. Nicholls. The Bungalow. Keele. Staffs, has written referring to some records from Croxden Abbey showing that the latter half of 1330, a year of total eclipse in July, was unusually wet—The year 1598 had a total eclipse in March and is recorded as a year of great drought with very hot August—1652, a year of total eclipse in April, is recorded as a year of drought, with the "duest summer known in Scotland". In 1715 (total eclipse in May) a wet June to August followed a dry May. Thus recent statistics and historical notes indicate that the weather in Britain, in the years of eclipse visible in Britain, varies in the same way as it does in other years.

No paper which could be described as purely meteorological in character appeared in the programme of the Leeds meeting of the British Association. Meteorology had, however, a bearing on subjects discussed in at least three sections. In Section A, for example, there was Prot J. J. Nolan's paper on "Ionisation in the Lower Atmosphere," while in the forestry sub-section of Section K, Dr C E. P. Brooks contributed a paper on "Forests and Rainfall"; there was also the combined discussion between Sections A, C, and K on "The Climates of the Past" Meteorology was in evidence throughout the meeting in the form of a demonstration of weather forecasting which was given daily in the Law Library at the Town Hall. This demonstration, indeed, has now become a feature of British Association meetings. It was arranged by the Meteorological Office, Air Munstry, in collaboration with the Signals Branch of the same department. Broadcast synoptic weather reports were received locally by radio twice daily, the observations being plotted on a chart of western-Europe as they were received. From the synoptic weather charts thus constructed, forecasts for the Leeds area were prepared. The forecast was mcluded in a local daily weather report, copies of which were distributed to the various section meeting rooms and to hotels and hostels where members were accommodated. The morning and afternoon synoptic charts were also reproduced on a large scale map in the Reception Room. In addition to the demonstration of weather forecasting, a comprehensive exhibit of instruments and diagrams was arranged, illustrating the various phases of meteorological work in Great Britain. Among the exhibits may be mentioned a series of five rain-gauges illustrating recent improvements in design, an exhibit illustrating the meteorological arrangements on the London-Continental air routes, and a series of stereoscopic cloud photographs taken from an areoplane.

The most popular method of distributing electrical energy at the present time is by means of alternating currents. It is sometimes necessary, however, to have direct currents, as, for example, to charge accumulators for storage purposes, for various systems of electric traction, and for experimental purposes. This has led to the invention and perfecting of various types of rectifiers. There are mercury vapour rectifiers, thermionic rectifiers, electrolytic rectifiers, and, for small currents, crystal rectifiers.

There are also rectifiers of the mechanical type, as the commutators on direct current dynamos and rotary converters. Vibrating reeds also are sometimes used. A new and novel type of rectifier, described by Dr J Hartmann, of Copenhagen, to Section G (Engineering) of the British Association on Sept. 5, has now to be added to the list It is called a jet wave rectifier He invented the principle of it so far back as February 1907, but many difficulties had to be overcome in the college laboratory and municipal power station at Copenhagen before it could be put on the market. The rectifier utilises the fact that a jet of mercury or other conducting liquid when passing through an alternating current magnetic field assumes a wave shape which depends on the frequency of the current If this jet is falling vertically and we have two conducting blocks, insulated from one another by a thin lamina of insulating material, the plane of which bisects the waves at night angles, then it can be adjusted so that for half the period the jet is in contact with one block, and for the other half in contact with the other block. Rectification can thus be obtained. It has been found that the corroding effects of the heavy sparks which ensue can be eliminated by making the commutation take place in hydrogen By means of three such commutators working in series, Dr. Hartmann has constructed a rectifier which converts 100 kilowatts, at 550 volts, alternating power into direct current power with an efficiency of 92 per cent. The author's paper is a valuable one It is being printed in full in Engineering, beginning on Sept 9.

Outdoor substations for electric lighting supply are now becoming fairly common in England shall watch this new development with interest North Metropolitan Electric Supply Company's generating station at Brimsdown was the first to be provided with an outdoor switchgear station. It is interconnected with the Barking capital station of the County of London Co., Ltd. As the outdoor gear controls the supply, it is impossible for it ever to be completely shut down for cleaning or repairs quently, repair work must be done when one set of the bus bars, which are at 33,000 volts, is 'alive.' To reduce painting to a minimum, it has been built of reinforced concrete, which is, unlike galvanised steel, impervious to the atmosphere. The circuit breakers are controlled electrically from inside the power house In the Electrical Review for Sept 9, outdoor substations of the North Metropolitan Co. at Cuffley, Hertford, Buntingford, and Royston are described The Cuffley substation is connected with the radial feeder from Brimsdown to Hitchin at Potter's Bar. A second radial feeder commencing at Cuffley feeds in turn Hertford, Buntingford, and Royston, where the feeder is extended to the Shepreth substation of the Bedfordshire, Cambridgeshire, and Huntingdonshire Electricity Co. The switchgear is mounted on a pipe framework embedded in concrete. The transmission is partly by 33 kilovolt underground cables and partly by 33 kilovolt overhead lines. At each substation there are banks of step-down transformers. In certain cases power can be supplied to the main line through the low pressure side of the transformers. The five stations at High Barnet. Potter's Bar, Welwyn, Stevenage, and Knebworth form the first part of a large ring main distributing system, an incoming and outgoing feeder being provided at each substation.

DISEASES of the heart take a high place as a cause of mortality, the present figure for Great Britain, 142 deaths out of every 1000, being considerably more than cancer Probably not less than 40 per cent. of all deaths from heart disease are of acute rheumatic origin, of which two-thirds is contracted in the years of childhood-5-15 years The Ministry of Health has therefore been well advised to publish a series of studies on the subject, by Dr. Eastwood, Mrs. Forest Smith, Dr J E A Underwood, and Dr J Alison Glover, with a prefatory note by Sir George Newman (Reports on Public Health and Medical Subjects. No 44 London: H.M Stationery Office, 1927. 1s 6d. net) The following statements (not advanced as 'conclusions') seem to emerge from the subject matter of the report. Acute rheumatism is probably a chronic progressive infection, thought by many to be due to a streptococus of the Viridans group, of low-grade, if of any, infectivity. Poverty and urbanisation are potent predisposing factors, but dampness of environment does not seem to be an important one. Focal sepsis, e.g. in decayed teeth and tonsils, is an important factor, and removal of unhealthy tonsils has considerable value in prevention. Once the child has sustained an attack, in order to minimise the risks of permanent damage to the heart and of recurrence at some future date, it requires (a)full in-patient hospital treatment for a period of from six to twelve weeks, and (b) special convalescent treatment and after-care for a further period of at least six months.

A VERY successful exhibition was organised by the British Aquanists' Association on Sept 6-10 at the Chelsea Polytechnic, and save for a small experimental show last year was the first of its kind held in Great Britain, and the largest show yet held in the world except the Steinhart Exposition, Philadelphia, which was not confined to fishes The arrangements were admirably carried out by a committee of which Dr. H. B Jones is chairman and Mr. A. W. Croser honorary secretary The primary object of the exhibition was to demonstrate to the public how aquaria may be set up with growing vegetation so as to be independent of change of water or artificial aeration. The difficulties of producing such an exhibition as this were exceptional, owing to the fragility of the tanks, the weight of water and shingle, the transport of live fish-especially tropical onesthe necessity of transferring them from the travelling cans to the show aquana, and the fact that fish must not be subjected to any sudden change of temperature. The proceedings were opened by Mr. E. G. Boulenger, who had acted as principal judge of the exhibits entered for the Haig Challenge Cup and numerous medals and diplomas. The Association includes members in Japan, China, America, and all over Europe; some of the fish on exhibition had travelled as far as from Glasgow. The 350 aquaria contained approximately 20,000 gallons of water, and about 8 cwt of shingle, totalling a weight of nearly 176,000 lb. More than 20,000 aquatic plants, apart from those entered for competition, were used to furnish the tanks.

The Heibert Spencer Lecture for 1927 was delivered at Oxford by Prof S. Alexander, who took as his subject "Art and Instinct", and the lecture has recently been published by the Oxford University Press, price 2s net Prof Alexander raises the question as to whether there is a specific esthetic emotion, or whether the asthetic attitude is nothing but ordinary feelings or attitudes towards the subjects of art in a certain condition of refinement and complication. If the claim for a peculiar æsthetic emotion is to be maintained, it must be traced to some impulse in human nature. Herbert Spencer derived art from the play instinct, and Burke from the instincts of self-preservation and of society, including therein sex After reviewing the attitude of Hume and Kant, Prof. Alexander submits that the æsthetic impulse and the æsthetic emotion accompanying that impulse are an outgrowth from the impulse of constructiveness, and are that impulse when it has become first human and next contemplative. With regard to instinct in general, he follows Prof. McDougall in his use of the word and also in looking upon constructiveness as an instinct. Between animal constructiveness and artistic production there is an intermediate stage of handleraft in which constructiveness remains practical but is humanised for a purpose. Purpose can only arise in a creature which possesses ideas and has memory.

PROF. ALEXANDER thinks that animals have 'construction' in a specific sense: in man it is more general, and might better be called 'synthesis' or 'constructional.' This synthesis, with its accompanying analyses, is the most obvious feature of science of all kinds, and so science may profitably be treated in its kinship with art; but while the lover of beauty adds his personality to Nature, the man of science sets himself by a supreme exercise of personality to keep his personality out Constructiveness becomes art when it ceases to be merely practical. When an object has been constructed it is there to be observed and can be used as the satisfaction of the constructivepassion itself. The passion takes possession of its object and lifts it out of practical consideration. It is not play, for play is still the shadow of practice. It is the constructiveness of play from which art is descended, and not the playfulness of it. Artistic construction is compelled in the artist by the excitement which certain subjects provoke, and he is at a certain remove allied to his brother the nightingale and his humbler and dowdier brother the beaver.

Yet art does add to the world a fresh reality even though based on ordinary reality. The lecture will interest all those concerned with psychology and with the theoretical and scientific aspects of art, but Prot. Alexander has not minimised the difficulties of the problem, and his readers cannot but feel that "much yet remains to be said."

An illustrated pamphlet has been prepared by the Ministry of Agriculture in conjunction with the Home Office to indicate the nature of the risks associated with farm machinery and to afford guidance as to the precautions necessary to secure proper standards of satety in connexion with its working (London · H.M. Stationery Office. 9d). Machinery of various types is considered, but stationary engines, transmission and barn machinery are dealt with in particular detail. Attention is directed to the importance of proper lighting and spacing in preventing accidents as well as to the necessity for efficient safety appliances, which may usually be obtained at a moderate cost. Steam boilers, electric and suction gas generating plants are briefly discussed and precautionary measures with regard to the storage of petrol or other inflammable spirit provided. Finally, the necessity for proper instruction of persons engaged in working the machinery, and the importance of having first aid requisites available is urged. A leaflet (No. 177) has also been added dealing with general precautions against accidents due to farm machinery.

SIR MURDOCH MACDONALD has been elected president of The Junior Institution of Engineers in succession to Engineer Vice-Admiral Sir Robert B. Dixon. Sir Murdoch will take office at a meeting to be held at the Caxton Hall, Victoria Street, S.W.1, on Friday, Nov. 18, when he will deliver his presidential address.

The Air Ministry has announced that a strong earthquake was recorded at Kew Observatory on Sept. 11, at 11.21 p.m. Its centre is estimated to have been 1700 miles away from the Observatory. There were two further shocks of much smaller intensity in the early morning of Sept. 12 Press messages report the occurrence of a severe earthquake in South Russia with a centre in the Crimea.

The study of the divining rod is being pursued by professors of geology and other men of science occupying positions of recognised importance in the universities of Central Europe  $\Lambda$  meeting of the Internationaler Verein der Wunschelrutenforschers is to be held at Hildesheim in October next, when a series of experiments will be conducted under the supervision of Prof F. Schoendorff. The results obtained will be published fully in the Zeitschrift of the Society

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A pathologist at the East Suffolk and Ipswich Hospital—The Secretary, The Hospital, Ipswich (Sept. 19). An

analytical chemist in the Medical Department of Tanganyika Territory with experience of foods and drugs analyses in a borough analyst's or similar laboratory—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W 1 (Oct. 1) A microbiologist for research work on sewage disposal problems—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Oct. 3). A junior technical officer for the Air Ministry Technical Development Staff—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (Oct. 5). A student probationer

for work at the Plymouth Laboratory—The Director, Marine Biological Laboratory, Plymouth (Oct 12). A physiological botanist and a biochemist for research work on cotton to be carried out at Coimbatore—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (Oct. 29). An agricultural botanist (male) as head of the biological department of the Seale-Hayne Agricultural College—The Principal, Seale-Hayne Agricultural College, Newton Abbot, Devon—A few civilian education officers, Royal Air Force—Secretary, Air Ministry, Adastral House, Kingsway, W.C.2.

#### Our Astronomical Column.

A Nova or Variable in Aquila —Plates taken at Konigstuhl Observatory by Prof. Max Wolf on July 30 and 31 showed a star of the ninth magnitude in the position (1927 0) R A 18h 52m 11 85°, S Dec. 3° 24′ 59 8″, which did not appear on twenty-five plates of the region taken between 1892 and 1926 On Aug. 17 its brightness had increased by half a magnitude. It appears on plates taken at Harvard Observatory on June 27, and also on one taken by J. Voute at Bandoeng on June 25, when its magnitude was 7 5, so that there appear to have been fluctuations of light. It was absent from a Harvard plate on June 8, being then below mag. 11 5. It was brighter visually than photographically in August, being fully of magnitude 8.

Prof. Wolf considered that the spectrum was of nova type on Aug. 17 P Guthnick and R Prager examined the spectrum with the 122cm reflector at Babelsberton Aug 19, when the hydrogen line H was seen and also numerous absorption bands Bright lines were suspected in the yellow and green, but they may have been merely the spaces between absorption bands. The character of the object as a nova is not yet definitely established, it may be an irregular variable. It is well placed in the evening sky and within reach of small instruments, so it should be followed.

GALE'S COMET.—Mr H. E. Wood, who has just returned to Johannesburg after a visit to England, has sent some further observations of Gale's comet, made there by Dr Innes; he has deduced from them an elliptical orbit, with a period of 11 86 years, equal to that of Jupiter. Dr A. C. D. Crommelin has reexamined the orbit, using an arc extending from June 22 to Aug 9, and confirms the ellipticity, the period found being 131 years, and perihelion passage June 14; the other elements do not differ much from the parabolic ones lately given in this column indicates that it is a member of the Saturn family, of which only three members were previously known; these are 1846 VI. (Peters) 1858 I. (Tuttle), and 1913 III (Neujmin), their periods are 1338, 13.51, and 18 years—Tuttle's is the only one that has been seen at more than one apparition. The addition of another member to this small family is therefore of considerable interest. Since it was bright enough to be detected by Mr. Gale with a binocular, it is rather surprising that it escaped detection at earlier returns, but the brightness of comets is subject to capricious variations, so it may have had an unusual increase of light at this apparition

METEORIC FIREBALLS.—Mr. W. F. Denning writes: "Reports have been received of two very large meteors observed from Somerset on Sept. 7 last. The first was noticed at 6<sup>h</sup> 3<sup>m</sup> P.M. (G.M.T.), when the sun

was shining It moved in a direction from east to west in a perfectly horizontal flight occupying about 7 seconds and was of a bluish-green colour. The object was very bright, and distinctly outlined on the clear blue sky There was no train left It was seen by Mr J. E D Beresford, Henstridge, Somerset

Somerset

"The second meteor was observed at 9<sup>h</sup> 25<sup>m</sup> PM.

(G.M T), and was a very fine object which traversed a nearly horizontal course from north to south, and showed a slight inclination toward the horizon immediately below the planet Jupiter. Its path was about 25° and duration of flight 3 seconds. It left a bright train of sparks. The observation was by Mr. A. Vowles, Minehead, Somerset.

"These brilliant meteors may very possibly have been derived from one or more of the systems which

"These brilliant meteors may very possibly have been derived from one or more of the systems which supplied the numerous fireballs reported from various parts of England in September 1926. Further observations will enable this point to be definitely ascertained"

According to letters which have appeared in the *Times*, these objects were observed over a wide area including Heathfield (Surrey), Seaford and Arundel (Sussex), Carisbrooke (Isle of Wight), Portland (Dorset), and Dinard.

EXCEPTIONAL STARS—Prof. H. N. Russell contributes a paper on this subject to the Scientific American for September—He notes that stars that differ from the general run, either by great brilliance or extreme faintness, are of special interest, and the most likely to add to our knowledge.

The stars of exceptional brilliance (absolute, not apparent) can now be detected by spectral peculiarities, or if Cepheid variables, by their period of light-change. The article states that the most luminous known star is a variable, S Doradus, in the lesser Magellanic Cloud, at a distance of 100,000 light-years; at brightest it gives 500,000 times the sun's light; one star in 200,000 gives 10,000 times the sun's light.

The extremely faint stars are much more common in space, but the difficulty of finding them is that they are only visible when they are near neighbours of the sun; even then they are generally very faint objects on photographic plates. They are singled out by their large apparent motions, which are revealed by comparing two plates of different date in a Blink micrometer. The most extreme of them was recently discovered in Virgo by Prof. Max Wolf at Heidelberg. Its proper motion is 4.84" a year, and Van Maanen has found that its parallax is 0.404" which makes it the third nearest star known, if we group Proxima and Alpha Centauri as one system. Its apparent magnitude is 13.5, from which it is calculated to give one fifty-thousandth of the sun's light or one twenty-five-thousand millionth of the star in Dorado.

#### Research Items.

POTTERY FROM TRUXILLO.—The Field Museum of Natural History has issued as No. 1 of Volume 2 of its Memoirs in Anthropology a preliminary report by Prof. A. L. Kroeber on a journey of archæological exploration in Peru on behalf of the Museum in 1925. Most of the exploration was carried out in the coastal areas of central and southern Peru; but this first part of the report deals only with the pottery art of the northern coast region in the vicinity of Truxillo. Here are the important prehistoric sites of Chanchan and Moche, the former the largest rum in Peru, the latter containing the highest pyramid, at least in the northern part of the country. Adjoining Truxillo to the north is the valley of Chicama, from which many of the specimens examined may have come though now labelled Truxillo. Truxillo is one of the centres yielding the Chimu type of pre-Hispanic pottery, for long the type, apart from Inca, best known outside Two varieties are recognised, one red and white classified by Uhle as proto-Chimu, the other black (sometimes coloured) known as Chimu. Three other types are also distinguished, which seem to point to an intercalation of influence from Tiahuanaco between the two styles. Nothing of true Tiahuanaco style or of red-white-black geometric has been discovered north of Truxillo. Prof. Kroeber's researches have been directed towards the problem whether the proto-Chimu style died out under outside influence, or whether it survived, as seemed likely, in attenuated form and was revived as late Chimu; but he has not arrived at more than tentative conclusions. He is inclined to regard the three colour geometric as later than Tiahuanacoid, while Dr. Uhle is disposed to regard it as earlier. His investigations lead to the conclusion that the proto-Chimu and Chavin styles are contemporary pre-Inca, showing traceable relations with the northern interior. Three colour geometric, a problematical middle Chimu, and the tripod and modelled styles are Tiahuanacoid and presumably pre-Inca, while late Chimu probably began in pre-Inca and continued into Inca and colonial times.

SUTHERLANDSHIRE SALMON.—In a report on the salmon from the River Hope and Loch Hope in Sutherland (Fisheries, Scotland, Salmon Fish., 1926, 7. Edinburgh and London: H.M. Stationery Office), Mr. G. H. Nall remarks on the results of the examination of 187 sets of scales collected during the years 1920-1925. A striking feature was the large percentage of fish that had spent three years in the river as parr, being 42 47 per cent., as against 6 per cent. among fish examined in 1920 from Thurso Bay. A further interesting point was the unusually large proportion of fish whose scales bore spawning marks. Amongst these was a male salmon, taken from Loch Hope on Aug. 17, 1921, weighing  $17\frac{3}{4}$  lb., which after spawning in its sixth year had returned to the sea, where it remained for two years before once more entering fresh water to spawn in its ninth year. This is the first example known to the Scottish Fishery Board of an Atlantic salmon, after once spawning, missing two complete years before returning from the sea to spawn in the third year, presuming that the scale reading was correct.

THE CALIFORNIAN SARDINE.—The sardine fishery in California which originated as a great fishery during the stress of war, has undergone striking development, and the industry has shown a vitality which augurs well for its permanence so long as the raw material is obtainable. The amount caught

exceeds by far that taken of any other species in California, and there appears at present no other which is capable of the tremendous yield, unless it be the unused anchovy. It has been recognised by the Fish and Game Commission of California, from experience with older fisheries, that rational use demands a knowledge of at least two things. There must, above all else, be information from time to time regarding the manner in which the species is withstanding the strain of the fishery. But there must also be an understanding of the natural changes in abundance which inevitably occur, so that these may be distinguished from the effects of overfishing and also may be foretold and understood. Based on such knowledge, regulation and exploitation may be rational and restrained. Fish Bulletin, No. 11 (California State Printing Office, Sacramento, 1926), includes five papers which are the first of a proposed series describing the initial results of the attempt of the Commission to establish a logical and adequate system of observation of the important fisheries of the State. Students interested in the collection and interpretation of statistical data on commercial landings of fishes will find much instructive information in these papers, including a study of the adequacy of various systems of sampling sardines which are used at Monterey.

THE LIMITS OF GROWTH.—In an essay (pp. 36. Jena: Gustav Fischer, 1927) on the limits of growth, Prof Richard Hesse seeks to establish the thesis that body size is a function of the surface of the gut. He brings forward many examples from the lower Metazoa in support of his view, e.g. the varying extent of the branches of the gut in ectoparasitic trematodes of different sizes, to show that in the organisms cited progressive increase in the gut surface. produced by branching, is associated with progressive increase in the size of the body. He cites a series of earthworms with a similar purpose, pointing out that the increase of gut surface is brought about chiefly by the formation of a typhlosole. In the small Allolobophora tetrædra this is a simple elevation, but in the stout Lumbricus terrestris the typhlosole is strongly developed and much folded. Prof. Hesse does not remark upon the absence of typhlosole in the largest of all known earthworms—*Megascolides australis*—which may attain a length of seven feet. The intestine in this worm is large, and possibly its surface, even in the absence of a typhlosole, is as proportionate as in Lumbricus to the size of the body, but it would be interesting to have data on this point.

Foraminifera of the Genus Lepidocyclina.—In the Proceedings of the U.S. National Museum, No. 2680, vol. 71, art. 8, Dr. T. Wayland Vaughan, of the Scripps Institution of Oceanography, La Jolla, California, describes some large and interesting foraminifera of the genus Lepidocyclina belonging to the sub-genus Lepidocyclina in which the two mitial embryonic chambers are characteristically of equal or sub-equal size, and are separated by a straight wall. Lepidocyclina Forresti is a new species from the Oligocene, originally found near Lynch Point, Antigua, where it was collected by Mr. W. R. Forrest in great abundance, packed closely in a cream-coloured, finely granular limestone. The species seems to have a wide range in the Antigua formation. Both microsphæric and megasphæric forms occurred, the former having a diameter of 18 mm., the latter 9 mm. to about 13 mm. A new variety of Lepidocyclina Mantelli (Morton) Gumbel is also described, and the

question raised as to whether the traditional form is the true L Mantelli or the new variety, which apparently occurs in the original locality of that species. Good microphotographs of all the forms studied, including surface views and sections, are given.

Animal Light and Symbiosis —Prof. Paul Buchner ("Tierisches Leuchten und Symbiose," pp. 58. Beilin Julius Springer, 1926) has published an address on this subject which he delivered at Lund in 1925. He points out that the history of the subject is short, for it began some fifteen years ago with an observation by Dubois on the luminous secretion of the boring bivalve Pholas dactylus. Prof Buchner considers first the light-producing organs of Pyrosoma, in which, as Pierantoni showed, the presence of micro-organisms is clearly demonstrable. The spores of this organism can be traced through the follicle cells surrounding the egg into transport cells, which are later found interspersed among the cells resulting from the discoidal cleavage of the egg, which occurs while the egg is enveloped by the follicle cells. When the first four individuals (ascidiozooids) of the new colony are formed, the new luminous organs, a pair in each individual, are formed from the symbiont-laden cells, that is, from maternal body cells. Examples are given of infection of the eggs of insects, eg Aleurodes, by transported symbionts. The luminous organs of fishes (e.g Anomalops) and those of cephalopods are described. Special attention is directed to those of Sepia elegans and S. officinalis—the organs known as accessory nidamental glands. These exhibit gland-like invaginations which form intertwining blind tubes in the lumen of which the bacteria live. Three kinds of tubular ingrowths are distinguished-white, yellow, and orange, but only the yellow ones send out light. Their bacteria are being investigated by cultural methods. The author has appended references to the original memoirs cited and has added remarks on many of them. The address gives a clear, concise, and interesting review of the present position of the

Drosophila Cripples.—A Mendelian character which is of especial interest on account of its wide range of variation has been studied by Prof. Taku Komai (Memoirs Coll. Sci., Kyoto Imp. Univ., Series B, vol. 2, No. 5) in Drosophila. This mutation expresses itself in a number of abnormalities of the middle and hind legs and its expression varies according to the condition of the food. The abnormality is called 'crippled' and is recessive, but it may fail to appear even in the homozygous state. The pairs of legs are quite differently affected, the front legs remaining unaltered. When the condition appears in the hind legs (crip.-h), one or more segments of one leg are shortened, crooked, twisted, or otherwise modified When it appears in the middle legs (crip.-m), one of them is reduplicated, small or absent. High or low temperature increases the percentage of crip.-h. The latter also appear more frequently in the early part of a culture, while crip. m flies only appear towards the end. This is due to some change in the condition of the food. Thus under certain conditions of the food, the hind legs (right or left) are affected, while under different conditions the middle leg is affected in a totally different way, but only one gene is involved. The reduplication of the middle legs takes various forms, some of which are exceptions to the rules of reduplication formulated by Bateson. The division of the legs may be either in the dorsoventral or the antero-posterior plane.

Japanese Land Mollusca.—Dr. H. A. Pilsbry, who has made special study of the Japanese mollusca,

has now begun a series of papers, the object of which will be to revise various ill-understood groups as opportunity offers. The first part (Proc Acad. Nat. Sci. Philad. vol. 79) deals first with the group of Eulota fiscina Fulton, which he places in a new subgenus, Kaiaftohelix. This differs somewhat in its anatomy, as shown in text figures, from Eulota proper. These forms are not directly related to any of the Japanese species southward, but are traceable to a separate migration from the mainland. The second portion of the paper treats of the races of Eulota (Euhadra) callizona Crosse, of which the distinctions, based solely on shell characters, are illustrated on two plates.

Volcanic Rocks of Upper Burma.—Continuing his investigations of the previously little known volcanic rocks of Burma, Mr. H. L. Chhibber describes a sense of typically 'Atlantic' types of late Tertiary to recent age from a region some seventy iniles north of Mandalay (Trans. Min. & Geol. Inst. of India, 21, 1927) The stratigraphy and tectonics were studied jointly with Prof L D Stamp. The older lavas have been completely altered by weathering, but appear to have been basic. These are followed by doleritic or teschenitic intrusions, including a probable laccolith. Finally come the younger lavas, forming a plateau. Like many of the Carboniferous lavas of the Midland Valley of Scotland, these rocks contain purple augite. They range in composition from olivine basalts to mugearites, and thus offer a remarkable contrast to the typically 'Pacific' rocks of comparable age which occur in the Lower Chindwin district fifty to sixty miles to the west. The latter rocks were recently described by Mr. Chlibber in the Journal of the Burma Research Society.

THE ATLANTIS PROBLEM. — The most plausible hypothesis yet advanced in explanation of Plato's account of Atlantis appears to be that of Paul Borchardt, argued at length in Petermanns Mitteilungen, 1927 (1), and briefly summarised in the Geographical Journal for Sept. 1927. The main block of North Africa is identified with Atlantis itself, and the Sea of the Atlantes with an inland gulf once connected with the Mediterranean and now represented by the depressed belt of the Shotts which stretches inland from the Gulf of Gabes. This tract is known to have been the seat of a former civilisation, and is, moreover, still subject to tectonic disturbances. It is thought that the lesser island of Atlantis with the legendary capital and temple may have been situated within the interior basin, a view that fits in with the description by Herodotus of Lake Triton with its templecrowned island The destruction of the island by earthquake would be a startling event, but not one beyond the limits of credibility. If Borchardt's hypothesis is sound, the "Pillars of Hercules" referred to by the Egyptian priest must have been wrongly interpreted by the Greeks. With this exception—and some confusion as a result of translation is not unreasonably to be expected—the details described by Plato are satisfactorily accounted for.

AR RESISTANCE FOR SPHERES.—In the issue of the Physikalische Zeitschrift for July 1, Dr. O. Flachbart gives an account of recent observations of the resistance of a smooth sphere of 24.2 cm. diameter in the wind channel at Gottingen. These experiments do much to clear up the differences which at present exist between the results of work done on this subject in the various aerodynamic laboratories. The sphere was supported entirely by suspending wires attached to a round rod 2 cm. in diameter and 30 cm. long which prefeted from the sphere in the down-stream

direction. The results obtained differ materially from those found at Gottingen in 1923 with the suspending wifes attached to the sphere itself. They show the great influence small irregularities in the surface of the sphere such as projecting eyelets or wires or encircling rings and turbulence produced in the air by even thin wires or meshes up-stream have on the resistance

THE EARTH'S ELECTRIC FIELD —Dr. H. Benndorf communicated to the Vienna Academy of Sciences on Mar 24 an outline of a new theory of the electric field of the earth which he has worked out with the view of indicating how the present aimless measurements may be replaced by more systematic ones. He takes a surface at a height H of 20 or more kilometres above that of the earth, at which it may be assumed that practically the whole of the electric charge of the earth and atmosphere lies beneath it. The electric field  $E_{\,\mathrm{H}}$ at this surface may be taken as uniform – If  $\lambda_n$  is the conductivity and  $\lambda_H$  the mean conductivity of the atmosphere at this height, the mean earth current z is  $E_{\rm H} \tilde{\lambda}_{\rm H}$  per sq. cm, and may vary with world time but not with local time. In a tube of flow extending downward from the surface H, if at any level the field and conductivity are E and  $\lambda$ ,  $E\lambda = z$  and the two equations give  $E = (z/\lambda_{\rm H}) (\lambda_{\rm H}/\lambda)$  in which the first factor depends only on world time and the second on local time. A comparison of this result with observations leads the author to believe that the daily variation of the field over the oceans is a measure of the daily variation of the total earth current, and that the theory is likely to present a picture of the phenomena of atmospheric electricity correct in its main features.

THE ISOTOPES OF LITHIUM.—M. Max Morand has given an account in the March-April number of the Annales de Physique of a new investigation of the isotopes of lithium. Guided largely by theoretical considerations, he has designed and built a tube in which the source of positive ions, a fine point covered with a layer of salt and raised as usual to a high positive potential, gives off a homogeneous directed pencil of charged particles of considerable intensity, which are analysed magnetically. In the case of lithrum he was able to separate the isotopes, and to measure simultaneously on two galvanometers the currents due to Li, and Li, which were present in the ratio of 15 to 1 required by the chemically determined atomic weight. The mass of metal which can be deposited in this way is still small, and only of the order of 10-5 gm. for the more abundant component, but M. Morand believes that with improvements in the apparatus it will be possible to increase the yield considerably.

MAGNETIC INDUCTION IN SHEET STEEL.—It is of the greatest importance to electrical manufacturers to know the magnetic induction produced by given magnetising forces in the sheet steel used in the cores of coils. A paper (No. 545) on this subject by R L. Sanford and J. M. Barry, of the Bureau of Standards, Washington, which has just been published, will prove of great value to designers. The Burrows' permeameter is the standard instrument in the United States for the magnetic testing of sheet steel. The Fahy Simplex permeameter has advantages in the way of simplicity and convenience of operation. Its accuracy, however, has been doubted, and comparisons made over a period of four years of results obtained by the two instruments have failed to throw light on the discrepancies. The present investigation was undertaken to decide which instrument was the better and to find out the conditions under which the best results could be obtained. The authors prove that the

differences between the results are mainly due to lack of uniformity in the physical properties of the materials under test. The simplex permeameter is less sensitive to this than the Burrows, but no inherent errors were detected in either instrument. The want of homogeneity in ordinary commercial samples of sheet steel will, in the great majority of cases, be less than in the samples used by the authors. Tests made with the Burrows' permeameter are in general satisfactory. To remove uncertainty, the uniformity of the specimen should be tested, but in many cases it is not convenient to do this. The authors conclude that for the normal routine induction testing of sheet steel, the Fahy Simplex permeameter is the best apparatus at present available. The specimens tested should be made up of 10 strips not less than 3 centimetres wide.

ARCING 'IN SWITCHES -Electrical engineers have devoted great attention to the problem of suppressing arcing in switches and to appliances for breaking the electric current in a circuit. They distinguish between an arc and a spark. In an arc, the flow of current depends mainly on the ionisation of the vaporised material of the electrodes, whilst in a spark it depends mainly on the ionisation of the gas surrounding the electrodes. The spectrum of the arc exhibits the spectrum of the electrode material and is practically independent of the surrounding medium In a paper by Sven Norberg in the March issue of the Journal of the Swedish General Electric Co., a careful study is made of the breaking characteristics of switches both in air and oil. He finds that the length of the arc in air is roughly 100 times greater than in oil. In designing a 'circuit breaker,' the final length of the are is much the most important factor. As we generally want to break the circuit quickly, the distance of the break should not be much greater than the length of the arc. To reduce the length of the arc it is advisable to have two or more breaks in series. With four breaks, for example, the length of the arc is reduced to at least one quarter its value. With an ordinary lamp load, the length of the arc is not affected by the speed of the break, but with an inductive loading the length of the arc increases with the speed of the break. A current of air or oil against the arc assists in extinguishing it. A magnetic 'blow out' acts in quite a different way from ordinary blowing. It does not affect the length of the arc, but it much increases the breaking speed. The conclusions arrived at in this paper show that the designer has mastered the electrical side of the problem, but much remains to be done before the mechanical side can be

CARBONISATION OF LANCASHIRE COAL .-- The Department of Scientific and Industrial Research has issued a pamphlet (Physical and Chemical Survey of the National Coal Resources. Paper No. 9 London: H M. Stationery Office. 1s. 6d. net) on the Lancashire Coal Field dealing with the Ravine seam (Part 2). This reports carbonisation trials in continuous vertical retorts made at the Greenwich Station with the use of mcreasing proportion of steam. The yields of products show a general approach to those reported in similar tests made on a good South Yorkshire coal, but difficulty was experienced owing to injury to the retort walls, ascribed to the nature of the ash. The report was supplemented by tests made on the coke when gasified in a blue water gas plant and in a suction gas producer and by trials of both coal and coke as fuel for a Lancashire boiler. In all cases the ash of the coal gave trouble either by attack on refractory material or by clinker formation. The report is one of the most comprehensive studies of a British coal in use which has been published.

#### Calcium Therapy.

THE subject of calcium therapy was discussed at the recent meeting at Edinburgh of the Section of Pharmacology and Therapeutics of the British Medical Association. Such a discussion must, of necessity, cover a certain amount of ground in which the interest is primarily clinical; nevertheless it furnishes an interesting summary of the present state of knowledge of calcium metabolism.

Evidently the interest of those working on the subject has, for the moment, three main foci, namely, the elucidation of the actual physical and chemical conditions in which calcium circulates in the blood and exists in the tissues; the point in the system of bones, blood, and tissues, at which the parathyroid hormone exerts its influence, and the relationships existing between, on one hand, ionic calcium, and on the other, the negative ions—chiefly,

of course, Cl'—in tissues and fluids. In spite of the adverse criticism which they have received, Vines's earlier results seem to have shown quite clearly that about 60 per cent of the blood calcium is in a state which differs, chemically, from the remaining 40 per cent Other workers, using different methods, have extended and amplified this conclusion It appears that, of the 10 mgm present in 100 c c. of normal serum, 6 mgm is diffusible through a collodion membrane, while 4 mgm. is combined, perhaps with protein or lipoid, in such a way as to be non-diffusible. While interest, for the moment, centres round the diffusible form, there is evidence that the non-diffusible, no less than the diffusible, is hable to variation in such circumstances as parathyroidectomy, or the administration of parathyroid extract

Of the diffusible calcium, probably 2 mgm. or so is in ionic form. It has been suggested that the remaining 4 mgm, may be combined with some substance of properties comparable, in this connexion, to those of citric acid. Quite probably, all three forms (if there be but three) are in equilibrium: variations in the amount of any one form must be reflected in variations in that of the others. It was, for example, pointed out that in prolonged diffusion experiments actually more than 60 per cent. of the total calcium passes into the diffusate, owing to the breaking up of the diffusible into the non-diffusible form.

Certain views 1 concerning the relationship of the parathyroids to calcium metabolism, implied rather than explicitly stated during the discussion, may be put into a fairly definite form

It has been clearly shown that injection of parathyroid hormone increases blood calcium without increasing absorption or diminishing excretion of the metal by the alimentary canal, since the typical rise can be obtained in anæsthetised, eviscerated animals. This rise must, therefore, occur at the expense of calcium either of the bones or of soft tissues,

 $^1$  A similar view has been expressed to the writer, independently, by Mr. Hoyle, of the Pharmacological Laboratory, Cambridge.

or of both. The hormone, in fact, must mobilise calcium from some reserve store. It appears that in certain cases of so-called 'renal infantilism'—a state in which nephritic changes accompany failure in body development—there occurs both a high level of blood phosphate, and a hypercalcæmia, associated with severe rachitic changes in the bones. A case was also described in which the bony changes known as 'osteitis fibrosa' were accompanied by a blood calcium level of 17 mgm. per cent., and the appearance of very definite adenomatous tumours of the parathyroids. It has been stated that young animals, fed on a calcium-poor diet, show definite parathyroid

hypertrophy.

Taken together, these observations seem strongly to suggest that, whatever the immediate source of the blood calcium, any prolonged rise in its amount results in the draining of the element from the bones. and that the action of the parathyroid hormone is in favour of such a transference A consideration of the relative amounts of calcium in the bones and the circulating fluid makes it obvious that only after a prolonged demand would any measurable effect be produced on the relatively enormous calcium store of the bones. It is well known that cardiac and nervous tissues are extremely sensitive to Ca /K balance, and it is difficult to imagine that any marked or prolonged rise in blood calcium would take place entirely at the expense of the soft tissues. Such data as are available suggest that calcium is concerned with the maintenance of cell surface structures, it is hard to picture such structures parting with calcium without the occurrence of marked disturbances.

The evidence concerning the point of action of vitamin D is, at present, meagre, and the subject still obscure. Some observations suggest that it promotes calcium absorption, possibly by some influence on the  $p{\rm H}$  of the intestinal tract. Obviously any agency tending to shift the reaction to, or to retain it at, the acid side of neutrality would favour the existence of soluble rather than insoluble calcium compounds. Such an explanation would, however, place the vitamin in the same category as a phosphaterich diet, which increases the rickets-producing power of a calcium-poor diet by hindering the absorption of the element. Evidence of the action of vitamin D on the mechanisms of bone formation, such as the phosphate esterase of Robison, is so far lacking.

Little light can at present be shed on the difficult question of the relationships of Ca" and Cl' ions, and of pH, in blood and tissues. It is suggested that the treatment of certain conditions, such as the cedema of nephritis, by calcium chloride depends as much on the readjustment of the Na /Cl' ratio as on any effect of calcium per se; it is well known that tetany is favoured by an increase, and tends to be relieved by a decrease of the alkali reserve, though Collip has shown that both in tetany and in hypercalcamia there is a terminal uncompensated acidosis.

### Congress of the History of Medicine.

THE sixth International Congress of the History of Medicine was held during the week July 18-23 under the presidency of Dr. J. G. de Lint, lecturer on the history of medicine in the University of Leyden. The meetings during the first three days were held at Leyden and the rest of the week at Amsterdam. The attendance was larger than at any previous congress organised by the International Society of the History of Medicine. No less than

twenty countries, among which Germany and Austria figured for the first time, were represented, so that the Congress, as many of the speakers remarked, was for the first time really international. Owing to the simultaneous annual meeting of the British Medical Association at Edinburgh, where a section of the history of medicine had been inaugurated, only a few British representatives, including Sir D'Arcy Power, Dr. Charles Singer, and Dr. J. D. Rolleston were present.

As on previous occasions, a great variety of subjects was discussed. Nearly ninety papers in all were presented to the Congress, but in the absence of their authors many had to be taken as read, and no speaker was allowed more than ten minutes for his communication. Anthropology was represented by papers by Dr. M. A. van Andel on folk medicine in myths and legends; by Prof A. W. Niewenhuis, on the views of primitive races on the sexual life of mankind, and by Dr V. Bugiel, on the personification of disease in Polish folklore. Classical antiquity was represented by papers on doctors and public opinion in ancient Rome, by Dr. R. Neveu; medical athletics in antiquity, by Prof. W. Haberling; ancient medicine and philosophy, by Dr. J. H. Lulofs; and terra cotta statuettes illustrating diseases from the Graeco-Roman museum at Alexandria, by Dr Angelica Panayotatou. Papers on medieval medicine included communications by Prof. Karl Sudhoff on medicine m the twelfth and thirteenth centuries; by Dr A. C. Klebs on a Catalan plague tract of April 1348, by Prof. P. Capparoni on a manuscript from the school of Salerno and an Italian translation of the thirteenth century of the "Thesaurus Pauperum, by Petrus Hispanus; by Prof. H. E. Sigerist, on St Sebastian; and by Dr. J. D. Rolleston, on St. Blase. Contributions to the history of anatomy consisted of papers on the development of anatomy in Spain shortly after Vesalius, by Dr. F Lejeune; Van Calcar's original drawing for the title-page of Vesalius's Fabrica, by Dr. Le Roy Crummer; and an unknown portrait of Vesalius, by Dr. F. M. G. de Feyfer.

Several communications dealt with the history of pharmacology, such as Johannes Mathaeus Faber's work on belladonna, by Dr. F. B. Kilmer, the origin of druggists' shops, by Dr. A. Schmidt; the deontology of the druggist in past ages, by Dr. O. van Schoor; and the title-pages of some old herbals and pharmacoporas published in Holland, by

Dr. H. Cohen

As was to be expected, many papers were devoted to Boerhaave, such as Boerhaave's prescriptions for some English patients, by Mr. C. J. S. Thompson, Boerhaave in Italy, by Prof. A. Castigliom: Boerhaave's letters to J. B. Barraud, by Dr. E. Darmstaedter; and La Mettrie's translation of Boerhaave's Aphorisms, by Drs. Laignel Lavastine and J. Vinchon Homage was also paid to Boerhaave's memory by a visit immediately after the opening ceremony to his tomb in the Peterskerk, by the inauguration of a memorial tablet in the house in which he died, and by the decoration of his statue with a wreath, on which occasion Dr. W. H. Welch, professor of the history of medicine at Johns Hopkins University, delivered an encomium on this great Dutch physician and clinical teacher.

Other papers relating to Dutch medicine apart from those on Boerhaave were Holland's contribution to clinical thermometry, by Dr. E. Ebstein; the first professor at the University of Leyden, by Dr. J. E. Kroon; Dutch hospitals as seen by a Frenchman, by M. Fosseyeux; and the history of spectacles in the

Netherlands, by Dr. H. Weve

The executive committee spared no pains to make the Congress a success by the arrangement of receptions, exhibitions, visits to places of interest, and the delivery of special addresses. Receptions were given by the Burgomasters of Leyden and Amsterdam, by the Minister of Public Instruction and Fine Arts at The Hague, by Mr. and Madame Fokker at Boerhaave's house, and by the Burgomaster of Enkhuisen during a trip on the Zuyder Zee, which included a visit to the picturesque inhabitants of Volendam.

Drs. B. W. T. Nuyens, F. M. G de Feyfer, J. van du Hoeven, and A. J. Lamers arranged a remarkable collection in the Municipal Museum at Amsterdam consisting of pictures by Rembrandt, Jan Steen, Teniers, and other works from various Dutch galleries, sculpture, books and incunabula illustrating the history of medicine. An interesting exhibition of instruments made by famous Dutch physicists in the seventeenth, eighteenth, and commencement of the nineteenth centuries was held at the physical laboratory of the University of Leyden, where Dr. C. A. Crommelin, the assistant director, gave an address illustrated by portraits of Huyghens, the Musschenbrocks, and other contemporary Dutch scientific workers. The same evening addresses illustrated by kmematograph films were given by Drs. A. Scherbeck and W. H van Seters on the work of Leeuwenhoek and Swammerdam Lectures were also given on the history of the treatment of nervous and mental diseases, by Dr C O. Ariens Kappers; the doctor in caricature, by Mr. C Veeth; and the bier of the surgeons and druggists preserved in the church at Wokkum, by Dr J B F van Gils.

The proceedings terminated with a banquet, when the speakers consisted of the president of the Congress, the president of the Society, Dr Tricot-Royer of Antwerp, the president-elect of the next Congress, Prof. Pietro Capparoni, and Dr. J. D. Rolleston, chosen by lot to propose the health of the ladies.

The next Congress will be hold at Rome in 1930, but the International Society of the History of Medicine will form a section in the Congress of the History of Science to be held next year at Oslo

### University and Educational Intelligence.

An institute for research in medicine is to be founded at Heidelberg. According to the Chemiker-Zeitung, the building will be creeted near the projected thermal bath and will contain special departments for research in pathological physiology, serum investigation, etc., and for the study of physics and chemistry as applied to medicine.

The Albert Agricultural College, Glasnevin, Dublin, which has been engaged in agricultural teaching and research since 1851, has recently been reorganised so as to accommodate the enlarged Agricultural Faculty of University College, Dublin (National University of Ireland), and will henceforth be under University control. The following appointments have been made: Director and professor of agriculture, Prof. J. P. Drew; professor of plant pathology, Dr. P. A. Murphy; lecturer in animal nutrition, Mr. E. J. Sheehy; lecturer in agricultural chemistry, Mr. Geo. Stephenson; lecturer in agricultural botany and bacteriology, Mr. M. J. Gorman; lecturer in plant breeding, Mr. M. Caffrey; lecturer in horticulture, Mr. G. O. Sherrard.

The British Institute of Philosophical Studies has arranged courses of lectures for the Michaelmas term by Prof. S. Alexander on "Value" (Truth, Goodness, Beauty); Mr. John Hobson on "Economics in relation to Ethics"; Prof. Leonard Russell on "The Approach to Philosophy"; Mr. Sydney E. Hooper on "Introduction to Philosophy", and Dr. William Brown on "Psychology". In the Lent term the Hon. Bertrand Russell will lecture on "The Philosophy of Physics," and Dr. Morris Ginsberg on "Social Psychology". In the Summer term Prof. Clement C. J. Webb will give a course of four lectures on "The Philosophy of Religion," and Prof. C. Lloyd Morgan a course of six lectures on "Mind in Nature". A full syllabus can

be obtained on application to the Director of Studies, 88 Kingsway, London, W C 2.

THE tutorial system of Oxford and Cambridge has, for many years, been well known in academic circles in the United States, its merits having been canvassed by returned Rhodes scholars and others, and somewhat sımılar systems having been introduced in Harvard and other American universities. The Harvard system is described in the January and April numbers of *The Educational Record*. Its main features are: each student at the end of the first year of his four-years' course is assigned to a tutor, who becomes thenceforth his adviser in all his studies, the tutors, at first chiefly young men, are now holding positions of all grades, from assistant to full professor; at least half of them combine tutoring with course lecturing; the number of pupils to a tutor who devotes his whole time to tutoring varies from 25 to 45. Conferences between tutor and pupil. commonly lasting an hour, take place once a week or fortnight in the second year, and once a week in the third and fourth, normally the students meet their tutors singly; the conferences are not in the nature of private lectures, most of the talking being done by the student, and have as little as possible to do with the ground covered in the courses taken; attendance by the student is entirely optional. The objects of the system are thus summed up: to devote more attention to the undergraduate as an individual, to treat him as a whole being (not, as under the American 'credit' system, as a conglomeration of intellectual fragments), to make him more largely educate himself, and to provoke in him an interest in so doing. It has increased the annual college teaching costs by about 45 dollars for each student.

EDUCATION in Finland is dealt with in a series of articles written by various authors for "Finland, the Country, its People and Institutions" (Otava Publishing Company, Helsinki, 1927), and issued as a separate pamphlet of fifty pages. This symposium, well printed in excellent English, and illustrated, comprises chapters on the elementary school system, secondary education, adult education, athletics, seats of learning, and the technical university. To the student of school systems the history of education in Finland is interesting, especially on account of the extraordinarily important place assigned to language teaching and the predominance in educational theory and practice of the influence of Uno Cygnaeus, the 'father of the elementary schools' Swedish, for centuries the official language of the country, Finnish, the mother-tongue of the bulk of the population, at least two of the great languages of the world, whether classical or modern, and, until recently, Russian, have all been included in the ordinary grammar school curriculum. The genius of Uno Cygnaeus, an enthusiastic follower of Pestalozzi, made a deep impression on his contemporaries and is to-day inspir-ing a movement towards a closer connexion with practical life, alike in elementary and secondary schools. Adult education is promoted by many agencies and is encouraged by State grants amounting, for the year 1926, to ten million marks. In 1920, Parliament decided to make the State directly responsible for the development of public libraries, and set up a libraries board, on which various educational organisations are represented, and a bureau, and divided the country into districts for propaganda and advisory work, with a library advisor in each. The principal seat of learning is the University of Helsinki (Helsingfors), a State institution. There are also two private universities, a commercial high-school, and a State technical university.

#### Calendar of Discovery and Invention.

September 18, 1883 — On Sept 1, 1883, W R. Brooks, at Phelps, NY., detected a comet which became an object of great interest owing to its identification with the Pons comet of 1812. This identity appears to have been first announced by the Rev. George M. Searle of New York in a letter published on Sept 18.

September 19, 1648—In Nov. 1647, a month after the death of Torricelli, Pascal suggested to his brother-in-law, Perier, the experiment of carrying a Torricellian tube up a mountain and noting the variation in the height of the mercury. It was not found possible to make the experiment until Sept. 19, 1648, when a party ascended the Puy de Dôme, near Clermont, equipped with a tube. At starting, the mercury stood at 26 in., but at the summit it had fallen to 23 in. "the party being greatly pleased at this, as indicating the relation between the height of the mercury and the height of the station."

September 20, 1849.—A patent of considerable interest in the early history of the applications of electricity is that of Staite and Petrie, E.P. 12,772, of Sept. 20, 1849. A method was devised to overcome the injury which the indium sustained when fused by a discharge between two carbon electrodes, and consisted in allowing the discharge to take place between an indium rod and the grains or powder of the indium it was desired to fuse

September 21, 1812.—On this date Count Francesco Zambeccari, accompanied by Vincenzo Bonaga, ascended near Bologna in a balloon of the Montgolfier type, heated by a lamp of the design of J. N. von Laicharding, an Innsbruck professor of natural history. The lamp burnt oil or spirit and was claimed to decrease the danger of fire to which the Montgolfier type of balloon was naturally subject. The wind blew the balloon against a tree, the branches of which upset the heating apparatus, the lamp exploded, the balloon crashed, and Zambeccari was killed.

September 22, 1859.—The publication of Rankine's work, "The Steam Engine," marks an epoch in the application of scientific principles to practical work. In his preface, dated Sept. 22, 1859, Rankine wrote: "The principles of thermodynamics, or the science of the mechanical action of heat, are explained in the third chapter of the third part more fully than should have been necessary but for the fact that this is the first systematic treatise on that science which has ever appeared, the only previous source of information regarding it being detached memoirs in the transactions of learned societies and in scientific journals"

September 23, 1846.—The planet Uranus, before its actual discovery by Sir William Herschel in 1781, had been observed as a fixed star on at least seventeen other occasions, beginning with Flamsteed in 1690. In the close study following its recognition as a planet, many irregularities were discovered which were outside the admissable limits of error. The investigations of Adams and Leverrier showed that no explanation of the motions of Uranus was admissible except that of a planet exterior to Uranus. It was at the Observatory of Berlin that the good fortune of discovering the new planet, Neptune, fell to the chief assistant, J. G. Galle, on Sept. 23, 1846.

September 24, 1852.—One of the earliest successful dirigibles was that of Henri Giffard, a Frenchman who, in 1852, invented a spindle-shaped gas-bag, propelled by a 3-h.p. steam engine. The ship was about 140 ft long and 40 ft. diameter, and contained 88,000 cubic feet of gas. The bag was enclosed in a net from which was suspended a spar 66 ft. long. The engine car hung from the spar. A short journey was made in the airship on Sept. 24, 1852, when a speed of about 3 miles an hour was attained.

W. C.

#### Societies and Academies.

LONDON.

Institute of Metals (Derby, annual meeting), Sept. 6 -L. Aitchison · Metals in modern transport (Lecture). In general, the properties that lead to the greatest employment of the non-ferrous metals and alloys are (1) A high resistance to corrosion. (2) High values of thermal or electrical conductivity. (3) A low value of specific gravity. In addition, the properties of ease of machining, ease of cold working, and simplicity of casting contribute to the wider usefulness of the materials. A high resistance to corrosion is a conspicuous feature of nickel and its alloys; this property is of service in cupro-nickel condenser tubes. The alloys of copper are for this reason also used in condenser tubes and turbine blading, and gun metal and phosphor bronze castings. Metals having a much lower specific gravity than iron and steel and mechanical properties comparable with those of the ferrous metals are of great importance in transport systems. The alloys that are actually employed are those based upon aluminium and magnesium. The alloys of aluminium at the present time are much more extensively employed than the alloys of magnesium. A variety of aluminium casting alloys can be employed, and are more or less interchangeable, but the majority of the wrought parts are made in duralumin. used in rail coaches and food containers, in constructing panels and structural sections in tramcars, motor-cars, and motor buses, in automobile engines and in aircraft. Various kinds of non-ferrous metals having tin, or lead, or copper as their basis are used as antifriction materials.

Sept. 7.—Marie L V. Gayler: The under-cooling of some aluminum alloys. The effect of under-cooling on the macro- and microstructure of some siliconaluminium and copper-aluminium alloys has been studied. It was not possible to under-cool 'modified' silicon-aluminium alloys systematically; the curves of solubility represented by the 'modified' diagram correspond closely to the supersolubility curves of the 'normal' alloys.—A. R. Raper: The equilibrium diagram of copper-tin alloys containing from 10 to 25 atomic per cent. of tin. The alloys have been examined both by thermal and micrographic analysis. The  $\alpha + \beta - \beta$  boundary shows a sudden change in direction at 580°, which together with other micrographic evidence favours Stockdale's view of a polymorphic change of the  $\beta$  constituent. The eutectoid point is at tin 16·15 (or 73 15 per cent. copper by weight), the temperature of the inversion being 520°. The 'transformation' curve has been determined carefully by thermal analysis; the slight horizontal at about 610° exists from tin 22.5 to tin 25 at a temperature of 638°. Evidence for a new eutectoid at tin 23 has been obtained .- F. Hargreaves: Effect of work and annealing on the lead-tin eutectic. A marked softening action of work at air temperature on the lead-tin eutectic is found. In the case of 78 per cent. reduction in thickness, the Brinell hardness is reduced from about 14 in the chill-cast condition to  $4\cdot 2$  when tested immediately after hammering. This value is actually lower than that of either constituent in the pure state -W. Hume-Rothery: Researches on intermetallic compounds (vi.). The reaction between solid magnesium and liquid tin. The reaction has been studied between 250° C. and 350° C. When a rod of magnesium is stood in a limited quantity of molten tin, the magnesium dissolves until the liquid reaches the equilibrium composition at the particular temperature concerned. Since, however, true equilibrium requires

the compound Mg<sub>2</sub>Sn (probably Mg<sub>4</sub>Sn<sub>2</sub>) as the phase in equilibrium with the liquid, a further reaction of the type, solid magnesium +liquid=solid magnesium stan-nide, tends to take place When sufficient magnesium has dissolved to give the liquid the equilibrium composition, all further direct reaction is stopped by a thin film of magnesium stannide which shows no appreciable thickening even after three weeks at the above temperatures. On the other hand, a few large crystals of magnesium stannide are sometimes formed by a slow reaction. This is probably the ordinary phenomenon of crystal growth due to surface energy effects, since the thin surface film has a high surface energy and so tends to form a more compact mass. But any solution at one point exposes more magnesium to the action of the liquid, and so the reaction gradually proceeds—W. T. Cook and W. R. D. Jones: The copper-magnesium alloys (Part 2). The ductility of these alloys depends primarily on the forging temperature If this temperature be low, the elongation and the reduction of area are impaired seriously, and the values are not restored by subsequent heat-treatment. The mechanical properties of copper-magnesium alloys containing up to 11 per cent. copper are not improved by simple heat-treatment, which causes a general decrease in test values. The addition of copper to magnesium up to about 2 per cent. is beneficial. Beyond this amount the increase in tenacity is small, whilst there is a regular decrease in ductility and a proportional increase in specific gravity. There is no advantage in adding more than this amount of copper to magnesium either for castings or for forgings.

Sept. 8.—C. J. Smithells, W. R. Pitkin, and J. W. Grain growth in compressed metal powder. The changes which take place in certain properties of bars of pressed tungsten powder when the temperature is gradually raised have been investigated. These changes are attributed to gram growth, which begins at a temperature determined by the particle size of the powder and the pressure used in forming the bar. Using powders with mean particle size 0.6-3.5µ, and pressures 8-32 tons/sq. in., the temperature at which grain growth could first be detected varied from 1100° K. to 1500° K— C. H. M. Jenkins: The constitution and physical properties of some of the alloys of copper, zinc, and cadmium. The general results indicate that the use of cadmium-bearing zinc does not produce any marked alteration in the physical properties of the brass. Additions of cadmium up to 1 per cent. by weight cause an improvement in the tensile strength, generally accompanied by a reduction in elongation. The effect is most noticeable in the cast 70:30 brass, and is less pronounced in worked material —H. Sutton and A. J. Sidery: The protection of aluminium and its alloys against corrosion. The resistance of aluminium, duralumin, and of certain other aluminium alloys to corrosion by sea-water is considerably increased by anodic oxidation and the subsequent application of a grease, such as lanoline. Electro-deposited coatings of zmc, 0.005 m. thick, afforded better protection to aluminium than did coatings of cadmium of similar thickness, but the two types of deposit appeared to give an approximately equal protection when applied to alloys of aluminium. Unsatisfactory results were obtained from nickel deposits of normal thickness.

—H. Sutton and J. W. W. Willstrop: The nature of the film produced by anodic oxidation of aluminium. The metallic aluminium is volatilised in dry hydrogen chloride. The films isolated from treated commercial aluminium sheet are usually of a grey colour, due to traces of carbon left behind when the aluminium sublimes as chloride, and they contain elementary

silicon. Films varying in thickness from  $0.033\mu$  to  $2\mu$  have been obtained, the thickness of the film produced by the usual standard treatment being about  $1\mu$ . From the volume of gas evolved by treated aluminium when heated in vacuo to 1200° C., the film is shown to consist of oxide and not of hydroxide.— W. Hume-Rothery and S. W. Rowell: The system magnesium-cadmium. The equilibrium diagram of the system magnesium-cadmium has been investigated by thermal and microscopic methods. The system contains a solid solution based on cadmium and denoted  $\alpha$ , a definite intermetallic compound MgCd<sub>2</sub>, and a solid solution in magnesium denoted  $\beta$ . The solid solution a extends from 0 to about 24 atomic per cent. magnesium at most temperatures. The compound MgCd, does not form any solid solutions, whilst the  $\beta$  solid solution extends from about 40 to 100 atomic per cent. magnesium The  $\beta$  solid solution undergoes a transformation at temperatures about 200° to 250° C., but the maximum temperature of this change is at 54 atomic per cent. The change seems to be of the same nature as that of the  $\beta$  brasses Prolonged annealing is necessary to attain equilibrium m the solid alloys in the neighbourhood of the compound MgCd2.—Cyrıl S. Smith: Note on cathodic disintegration as a method of etching specimens for metallography. Silver-copper alloys are particularly suited for etching by this process, which causes stainmg of the copper-rich constituent as well as removal of the silver.

#### PARIS.

Academy of Sciences, Aug. 17.—Akımoff. Fourier-Bessel transcendentals with several variables.—F Gonseth and G Juvet The metric in space of 5  $\,$ dimensions of electromagnetism and of gravitation.

—B. Cabrera and A Dupérier: The paramagnetism of the palladium and platinum families.—A. Duboin: The application to the oxides of iron and neodymium of a general method of synthesis of silicates.—Georges Lumet and Henri Marcelet: The utilisation of marine animal oils and fish oils in motors. These oils have been used to work a Diesel-Hindl motor without special adjustment. The power of the motor was practically unchanged when the fish oils were sub-stituted for gas oil. Corresponding with the lower calorific value, more fish oil than gas oil was required. The only difficulty was caused by the higher viscosity of the fish oils, and this was overcome by a preliminary heating.—J. Dadlez: The proportion of nitrous fumes in the neighbourhood of an arc lamp used for medical treatment. Under normal conditions the amount of oxides of nitrogen produced are without danger, but in a small room efficient ventilation must be provided.

Aug. 22.—A. Lacroix: The lithological constitution of the volcances of the central southern Pacific. The volcance islands in the southern Pacific Ocean can be grouped under three lithological series, nephelimic, intermediary, and without nepheline. The strict classification of eruptive rocks into a Pacific type and an Atlantic type cannot be maintained in this form.—Riquier: The numerical resolution of certain systems of integral algebraical equations with any number of unknowns.—C. Sauvageau: The continuous growth of certain annual Pheosporese—Charles Nicolle and Charles Anderson: The experimental transmission of the spirochete of Spanish recurrent fever by Ornithodorus moubata and the mechanism of this transmission. O. moubata is capable of transmitting not only the Dutton spirochete of which it is the natural transmitter, but also two others, one of which is allied to the Dutton spirochete, the other quite different. The mechanism

of transmission in these cases is the same, it is a natural transmission—Georges J. Remoundos Anew generalisation of the Picard theorem—Léon Pomey: The existence of non-linear differential and integral equations (with any number of variables) of which solutions exist in the same domain as the coefficients (normal non-linear equations).—J. A. Lappo-Danilevski. The algorithmic resolution of the problem of Poincaré concerning the construction of a monodrome group of a given system of linear differential equations—Miron Nicolesco: Bipoint functions and conjugated areolairely functions —René Lagrange: Certain suites of polynomials — De Fleury: The forms of the combustion chambers in internal combustion motors and their effect on endurance. The best practical constructive solutions of the problem tend towards very high compressions, with explosion chambers possessing a high ratio of surface to volume for combustibles such as petrol liable to develop an explosive wave.—F. Gonseth and G. Juvet: Schrodinger's equation —W. Kopaczewski and M. Rosnowski. Electrocapillary phenomena and the ions —Tr. Negresco: The quantitative sensibility of the lines of the spectrum. The sensibility of any given line in the spectrum, in a given source of emission, depends uniquely on its intensity in the spectrum of the pure metal obtained under identical conditions.—Henri Marcelet: The determination of some physical constants of marine animal oils. The data given for thirty different oils include the heat of combustion, flash point, specific gravity, and viscosity.—A. P. Rollet: The behaviour of various metals in the electrolysis of water by the alternating current.-Mme. N. Demassieux: The action of oxalic acid upon some soluble salts of lead .-- W. Ipatieff and W. Niklaeff. The action of hydrogen upon tin salts at high temperatures and pressures. At 300° C., with hydrogen under 38 atmospheres pressure, hydrated tin oxide is reduced to the stannous state; at 350° C. and 50 atmospheres, the reduction goes further to metallic tm. Stannic sulphate  $(302^{\circ}$  C. and 50 atmospheres) gives stannous sulphate in solution and crystals of stannous sulphide.—L. Hackspill and E. Rinck: The reciprocal displacement of sodium and potassium from their chlorides. An experimental study of the reaction KCl+Na=NaCl+K.—André Léauté: The low temperature distillation of long flame coals agglomerated by tar or a tar oil. The experiments described were directed towards the determination of the best proportion of oil or tar giving a hard solid residue.—Pereira de Sousa. A new deposit of intrusive rocks containing sodium in Portugal.—J. Lacoste: The experimental determination of the dynamic magnification of seismographs with platform.—L. Petitjean: A periodicity and symmetry of the rainfall curve at Algiers Application to the prediction of dry and rainy periods in Algeria.—Cam. De Bruyne: Contribution to the study of the nutritive process of the oosphere of the Abietineæ.— H. Colin and A. Augem: The nature and metabolism of the glucides in the Iris—F. Viés and A. de Coulon: The interpretation of the curves of the receptivity index of mice for grafts of tumours.—S. Voronoff: The results of the grafts on the flock of sheep of the Gouvernement général d'Algérie.

#### SYDNEY.

Linnean Society of New South Wales, July 27.—H. J. Carter: Australian Coleoptera: notes and new species (No 5).—G. H. Cunningham: The Gasteromycetes of Australasia (9): Keys to the genera and species of the Lycoperdaceæ. The ontogenetic position of each of the genera is discussed and an artificial key based on structural similarities and differences is

proposed.-J. R. Malloch: Notes on Australian Diptera (No 11). A full account is given of the Australian Calliphoridæ, and the family is divided into Calliphorinæ, Metopiinæ, Sarcophaginæ, Chrysomyiinæ, and Rhinunæ.—A. M. Lea · Descriptions of new species of Australian Coleoptera (Part 19). Two new genera and 38 new species of beetles of the family Curculionide, mostly from Queensland, are described—

J. McLuckie and A. H. K. Petrie. The vegetation of the Kosciusko Plateau (Part 1) The plant communities. Three zones are recognised: alpine, subalpine, and montane. The three great types of communities are (a) Eucalyptus forest, represented by the E corracea, E. Gunnii, and E. stellulata consociations; (b) grassland represented by the Poa consociation and the Poa-Celmisia association; (c) the marsh vegetation The factors controlling the timber line and the interrelations of the communities of the marsh vegetation are also discussed

#### Official Publications Received.

BRITISH

Jamaica. Annual Report of the Department of Agriculture for the Year ended 31st December 1926. Pp. 29. (Jamaica, B.W.I. Government Printing Office, Kingston.)

Canada. Department of Mines. Geological Survey. Summary Report, 1925, Part C. (No. 2118.) Pp. 175c. Summary Report, 1926, Part B (No. 127) Pp. 57B. Memori 151, No. 132 Geological Series Minto Coal Basin, New Brunswick. By W.S. Dyer. (No. 2115.) Pp. 1142. 15 cents. Memori 152, No. 133 Geological Series. St. Urbain Area, Charlevoix District, Quebec. By J. B. Mawdsley. (No. 2120.) Pp. 11+58. 20 cents. (Ottawa: F. A. Acland.)

The North of Scotland College of Agriculture. Calendar, Session 1927-1928. Pp. vin+122. (Aberdeen.)

Nigeria. Annual Report on the Agricultural Department for the Year 1929. Pp. 20. (Ibadan.)

Report on the Administration of the Meteorological Department of the Government of India In 1926-27. Pp. 17+3 plates. (Sinila Government of India Press.)

the Government of India n 1926-27 Pp. 17+3 plates. (Simia Government of India Press.)
Western Australia: Geological Survey. Bulletin No. 85. A Geological Reconnaissance of part of the Ashburton Drainage Basin, with Notes on the Country southwards to Meekatharra. By H. W. B. Talbot; with an Appendix on the Minerals of the Ashburton and Gascoyne Valleys, by Dr. Edward S. Simpson Pp. 113+5 plates. (Perth: Fred. Wm. Simpson)

Dr. Edward S. Simpson Pp. 113+5 plates. (Perth: Fred. Win. Simpson)
Sit John Cass Technical Institute, Jewry Street, Aldgate, E.C. Syllabus of Classes, Session 1927-1928. Pp 119. (London.)
Union of South Africa Department of Agriculture Science Bulletin No 60: Some Changes occurring during the Ripening of Grapes. (Third paper.) By P R. v. d. R. Copeman. (Division of Chemistry Series No. 75.) Pp. 19. (Pretoria: Government Printing and Stationery Office) 3d. Aeronautical Research Committee: Reports and Memoranda. No. 1075 (Ae. 257): Lateral Stability at Low Speed. By S. Scott Hall. Part 1. Measurement of Rolling Moments for Three Wings at Low Rates of Roll; Part 1. Pressure Measurements on a Wing whilst Rotating at Low Speeds. (A.2a. Stability Calculations and Model Experiments, 120.—T 2582.) Pp. 13+20 plates. 1s. net No. 1083 (Ae. 262): The Influence of the Airscrew on the Aircraft Characteristics of a Standard Bristol Fighter Aeroplane. By W. G. Jennings. (A.4c. Full scale Work-Airscrews, 37—7. 2383.) Pp. 4+8 plates. 4d. net. No. 1085 (Ae. 264): Lift and Drag of the Bristol Fighter with Fairey Variable Camber Wings. By E. T. Jones, L. E. Caygill and Dr. R. G. Harris. (A.3 b. Aerofolis with Flaps or Warped, 27; A.4.b. Full scale Work-Parts of Machines, 29.—T. 2412.) Pp. 12+10 plates. 9d. net. (London: H.M. Stationery Office)

The University of Leeds. British Association for the Advancement of Science, Leeds Meeting, 1927. University Reception, Tuesday, September 6th, 1927, 8 p.m.-10.30 p.m. Pp. 27 (Leeds)

Foreign.

University of Colorado Bulletin Vol. 27, No. 6, General Series No. 243: Catalogue, 1926-27; with Announcements for 1927-1928. Pp 439. (Boulder, Colo.)

Proceedings of the Imperial Academy. Vol. 3, No. 6, June. Pp. xv-xvi+307-385. (Tokyo.)

Nauka Polska: La Science Polonaise. Tom 8. Pamietink II Zjazdu Naukowego odbytego w Warszawie w dniu 2-3 Kwietina 1927 Roku: Memoire du II Congres scientifique tenu à Varsovie les 2 et 3 Avril 1927 pour étudier la question de l'organisation de l'enseignement supérieur en Pologne. Pp 97. (Warszawa: Im. Mishowskiego)

Agricultural Experiment Station, Michigan State College of Agriculture and Applied Science. Technical Bulletin No. 90: Virus Diseases of Raspberries. By C. W. Bennett. Pp. 38+11 plates Technical Bulletin No. 81: Storage and Transportational Diseases of Vegetables due to Suboxidation. By Ray Nelson. Pp. 38+8 plates Technical Bulletin No. 82: Commercial Casein. By A. C. Weimar and John Taylor. Pp. 16. Technical Bulletin No. 83: A Study of the Sanitary Significance of Air in relation to Ice Cream. By F. W. Fabian. Pp. 30. Circular Bulletin No. 105: Farm Lesse Systems in Michigan. By F. T. Riddell. Pp. 18 Circular Bulletin No. 105: Sweet Corn. By G. E. Starr. Pp. 19. Special Bulletin No. 166: Studies in Orchard Management, with Special References to Cherry Production. By A. J. Rogers, Jr. Pp. 48. (East Lausing, Mich.)

Department of the Interior Bureau of Education. Bulletin, 1927, No 3: School Hygiene and Physical Education. By Dr. James Frederick Rogers. Pp. 20. 5 cents. Bulletin, 1927, No 8. Recent Movements in City School Systems. Dy W. S. Deffenbaugh. Pp. 26. 5 cents Bulletin, 1927, No 9: Medical Education, 1924-26. By Dr. N. P. Colwell. Pp. 14. 5 cents. (Washington, D.C. Government Printing

Office)

Department of Commerce Bureau of Standards Scientific Papers of the Bureau of Standards, No. 550 · Application of the Algebraic Aberration Equations to Optical Design By I C Gardner Pp. 71-203 45 cents Scientific Papers of the Bureau of Standards, No. 552 Transmission of Sound through Building Materials By V L Chrisler Pp. 225-225 5 cents (Washington, D C Government Printing Office) Agricultural Experiment Station of the Bhode Island State College Bulletin 208 The Production of Gas by Salmonella millorum By Kenneth Goodner and Henry G May Pp. 12 Bulletin 209 The Degree of Response of Different Crops to various Phosphoius Carriers By Burt L Haitwell and S C Damon Pp. 20 (Kingston, R. 1)

#### Diary of Societies.

#### TUESDAY, SEPTEMBER 20

Institute of Marine Engineers (at Olympia), at 3—E. F. Spanner. The Case against the Auship —A. C. Hardy Motor Ships in relation to World Trade Routes.

#### FRIDAY, SEPTEMBER 23.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Midland District Meeting) (at Building Research Station, Garston, near Wattord), at 11 AM

#### SATURDAY, SEPTEMBER 24.

Institution of Municipal and County Engineers (South-Eastein District Meeting) (at Heine Bay), at 11 a m.

#### CONGRESSES.

#### SEPTEMBER 15-17

ANNUAL CONFERENCE OF WOMEN ENGINFERS

Saturday, September 17, at 2 15 (at Crosby Hall) —Miss Iris Cummins Water Power and the Electrification of the Irish Free State

#### SEPTEMBER 18-OUTOBER 3

International Concress of Theoretical and Applied Limnology (at Rome) In four sections 'Physics and Chemistry, Geology and Hydrography, Biology, and Applied Limnology.

SEPTEMBER 20-22.

RON AND STELL INSTITUTE (Autumn Meeting) (at Royal Technical College, Glasgow), at 10 A.M.—Propers to be submitted:—D. F. Campbell High-Frequency Induction Melting.—H. A Dickie. Magnetic and other Changes concerned in the Temper-Isrittleness of Nickel-Chromum Steels—Prof. C. A. Edwards and K. Kinwada. The Influence of Cold-Rolling and Subsequent Annealing on the Hardness of Mild Steel—A. B. Everest, T. H. Tunner, and D. Hanson. The Influence of Nickel and Silicon on an Iron Carbon Alloy—C. S. Gill: The Effect of Varying Ash in the Coke on Blast-Furnace Working—D. Hanson: The Constitution of Silicon Carbon Iron Alloys, and a New Theory of the Cast Irons.—E. G. Herbert. The Work-Hardening of Steel by Abrasion.—K. Honda and K. Takahasi. On the Quantitative Measurement of the Cutting Power of Cutlery—E. H. Lewis. The Use of Silica Gel as a Medium for Drying Blast—T. Matsushita and K. Nagasawa. The Mechanism of Tempering of Steels.—T. W. Robinson The Economic and Social Development of the American Iron and Steel Industry.—Dr. W. Rosenhain and D. Hanson. The Behaviour of Mild Steel under Prolonged Stress at 300° C.—J. H. Smith and F. V. Warnock: A. Testing Machine for Repeated Impact, and a Preliminary Investigation on the Effects of Repeated Impact, and is Precipitation.—F. Wust: A Contribution to the Theory of the Blast-Furnace Process Blast-Furnace Process

#### SEPTEMBER 23-26

SEPTEMBER 23-26

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at Trinity College, Cambridge).—Subjects for discussion: Report of the Public Libraries Committee of the Board of Education (A. E. Twentyman and Lieut -Col. L. Newcombe); Recent Developments in connexion with the Science Library, South Kensington (Sir Henry Lyons); Information, Organisation, and Statistics in Industry (Major L. Urwick, S. J. Nightingale, H. Quigley, W. Wallace, A. E. Overton, F. W. Tattersall), Patent Classification (A. R. Wright, A. Gomme); Problems of the Information Bureau (A. F. Ridley, P. K. Turner, Dr. J. C. Withers); Photographic Reproduction of Printed and MS. Material (N. Parley, Sir William Schooling, R. H. New); Standards of Book Selection in Science and Technology (Sir Richard Gregory)

#### SEPTEMBER 26 AND 27.

CERAMIC SOCIETY (Refractory Materials Section Meeting) (at Town Hall, Bournemouth), at 10 AM.—A. T. Green: A Consideration of Steel Works Refractories.—W. J. Rees and W. Hugill: Note on Silica Bricks made without Added Bond.—R. S. Troop: Some Experiments in the Drying of Clays.—W. O. Hancock: Crushing Strength of Unfired Fireclay Bodies.—A E. J. Vickers. Determination of Iron Silicates.—Prof. D. A. Moulton: Refractory Material used as Mortar for Laying up Refractories.—Dr. A. F. Joseph: Characterisation of Clay.—A. J. Dale: Effects of Temperature on the Mechanical Properties of Silica Products.



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#### Imperial Mineral Oil Resources.

DISTINGUISHING, if not the chief, merit of a periodic congress is the opportunity afforded for taking stock and gauging progress of development, particularly when the terms of reference connote applied science. Even if deliberations produce nothing startlingly new, as is often the case, the inevitable correlation of independent lines of reasoning and research serves as a stimulant to the delegate mind and creates a wider perspective, at the same time tightening the grip on essentials. This in turn has its natural repercussion amongst the greater body of workers, and thus is the spirit of technology constantly enlivened.

Petroleum is a case in point. Its consideration at the second (triennial) Empire Mining and Metallurgical Congress, judged from the papers now available, is largely recapitulatory, but there is clearly apparent the aim at such co-ordination of data as may lead to some solution of the thorny problem of Imperial mineral oil resources and future supplies. The setting for such a discussion, Canada, is singularly appropriate, though paradoxical while it emphasises the truly Imperial aspect of the question, it throws into sharp relief the unfavourable position of that great Dominion, the contribution of which is less than 0.02 per cent. of the world's petroleum production; like Great Britain, Canada is dependent on foreign sources of supply for her needs.

The problem resolves itself into a dispassionate survey of hard facts: the maximum quantity of petroleum won from truly Empire sources lies between two and three million tons per annum, these limits constitute a reasonable estimate for the future. On the other hand, the total consumption of petroleum products in the Empire amounts to between ten and eleven million tons per annum, and is likely to increase considerably with each successive year. Thus Empire resources are hopelessly inadequate even for present needs. There follows the natural question: What exactly are our Imperial petroleum resources, both actual and potential, and to what extent is the British Empire committed to foreign oil supplies in the future? Failing a satisfactory solution in the shape of technical guarantees, what is the alternative to the existing situation?

In substance these questions are not new; they have been raised a hundred times both on the platform and in print; they have been answered in diverse ways, but always with strong individual bias. The optimistic predictions of undeveloped

oil-pools, shale-oil prospects, coal and liquid fuel substitutes, and similar panaceas variously prescribed to meet ultimate contingencies, are well known. In the light of present knowledge, such unbounded optimism is premature. At the moment the circle of argument, like that of the origin of petroleum, is still intensely vicious, but there are signs that this second Congress may be destined at last to break it.

To clear the ground, a distinction must be drawn between truly Imperial oil resources and those, though developed by Imperial interests, situated in extra-Imperial territory; this is a point usually overlooked, but it is all-important to the present issue. Thus in the first category are placed India (with Burma and Assam), Trinidad, Sarawak, Egypt, and Canada, expansion is probable in the first three, extremely doubtful in the two remaining countries; to the same list may be added potential resources of New Guinea and North Borneo. Much is heard of the untapped oil reserves of the main continent of Africa, also Australia and New Zealand; unfortunately, the wish fathers the thought. Technically, the evidence tends to discount the discovery in these lands of major oil-pools destined to weigh heavily in the scheme of things; the great red spaces on the map of the world which depict Imperial terrain, he, with one exception, tantalisingly outside the girdle of prolific oil production

Imperial petroleum interests in foreign countries are highly ramified and are of supreme economic and political import; they embrace Mexico, Persia, Venezuela, Peru, Argentine, Colombia, Rumania, and Galicia, among others. Russia is a problem unto itself, with oil as with politics; the march of time may determine the resumption of international competition for her undeveloped resources, with British interests reasserted, but prophecy concerning this unhappy country is dangerous. 'Iraq fascinates by its yet unproven possibilities, as also other regions of south-west Asia: Empire commitments here are much entangled with foreign policies, perhaps not disadvantageous in the long run. But the crucial point to remember is this: these countries constitute resources to the Empire only so long as political relationship is stable and international commerce is untrammelled by inimical legislation or actuality of war. Admittedly it is hard to imagine the extreme circumstance in which all these channels of supply would be blocked, especially in the light of experience gained during the War, but there is danger in the position as it stands, which would be intensified a hundred-fold

if, for any reason, American sources were made unavailable for Imperial markets

The predominating position of the United States in the economics of world-supply and consumption of petroleum products has been defined so often as to be common knowledge; further statement is therefore superfluous here. To-day the Empire's dependence on that country for oil is as great as ever, for increased consumption more than balances increased production from extra-American sources. So long as one country is responsible for more than 70 per cent (80 per cent if Mexico is included) of the total annual output of a vital commodity, so long must it be the keystone of the whole economic structure, national and foreign, on which the relevant industry is reared. The free distribution of American oil supplies to Empire markets can only be disturbed by two eventualities. curtailment of exports to conserve national resources, or declaration of war. The first is feasible, in fact ultimately probable; the second is unthinkable, at least to the present generation. In any event, the fact that Imperial resources are totally insufficient to meet present necessities, much less any possible emergency arising from diminished trans-Atlantic supplies, serves only too well to indicate the real state of affairs. Moreover, in no other part of the world is it possible to predict, with confidence based on all available knowledge, the existence of undiscovered petroliferous territory of the magnitude and persistence of that possessed by the United States; geological work all over the world, though the detail of remote regions may still be lacking, is at least sufficiently comprehensive to justify that assertion.

Thus hopes of independence of foreign sources of oil production vanish quickly when the situation is carefully examined. In the course of his address to the Congress, Sir Thomas Holland stated the case succinctly: "Under normal conditions we must depend on outside sources for a seriously large part of our petroleum products; " and again, "It is important to remember that in case of temporary isolation, even the Empire sources of crude oil may not be accessible. In any event, they would be quite insufficient even if they were available to the full. . . ." It is quite impossible to encourage the slightest hope that the consumption-factor of eleven million tons or more of petroleum products per annum within the Empire can ever be attained by the utilisation of indigenous supplies. Thus technical guarantees fail and we are thrown back on alternative remedies.

Sir Thomas Holland invited the Congress to consider six points which we may summarise as follows: (1) Prospects of maintaining or extending Empire production of crude oil, (2) the extent to which oil-shale exploitation may supplement mineral oil supplies, (3) prospects of obtaining oil from low temperature carbonisation, (4) possibilities of oil substitutes obtained by processes similar to hydrogenation of coal, (5) prospects of alternative liquid fuel, e.g. alcohol, and (6) increased production of light oils by cracking processes, etc

The value of these headings lies in the fact that, as set out, they take nothing for granted, they presuppose no immediate remedy to be applied the moment emergency arises; they sponsor no premature optimism. The merit of the discussion along such lines lies in getting at the root of the whole matter, it is tantamount to saying, "Let us get clear for the moment from mere experimental data, from small-scale ideas which have scarcely transgressed the academic border-line What are the large-scale possibilities of these alternatives? Which are, and which are not, of commercial application, from which a definite solution of the problem can alone spring ? " Prof. Nash's paper on "Possible Auxiliary Sources of Liquid Fuels" should do much to focus attention on the true perspective of this subject; he is impressed with the many technical difficulties to be overcome before substituted fuels can compete with petroleum products, especially at current prices.

The problem thus debated is bound to open out along the right lines. Economic policy and military security of the Empire demand some tangible solution to the fuel question in the near future. It is useless to leave things to chance, it is unworthy to allocate the task to posterity. The suggestion has been made that standing committees should be formed in each Dominion to watch commercial petroleum developments, to inspire technical activities, and to translate results in terms of Imperial requirements. Nothing should be allowed to hamper the fruition of any scheme to this end. Organised research, conceived and executed on a large scale, or at least with the view of commercial requirements, should receive all the backing from the governments concerned that it is possible to give; the need for this was proclaimed loudly at Wembley in 1924; it is clear that the second Congress has vigorously affirmed this demand; it is to be fervently hoped that its efforts will not be in vain. н. в м

#### Flame and Combustion.

Flame and Combustion in Gases. By Prof. William A Bone and Dr. Donald T. A. Townend. Pp. xvi + 548 + 30 plates. (London: Longmans, Green and Co, Ltd, 1927.) 32s. net.

THE world to-day simply lives upon explosions: it moves and has its very being, in the air and on the roads, upon and under the waters, through the agency of flame The publication of a book dealing comprehensively with a subject of such public importance, by a master-worker, is therefore most opportune. It is so well-written that it should rank as a 'best-seller' with Ludwig's "Napoleon" and gruesome "Jew Suss," being as readable and exciting as a "Greenmantle" or a Mason 'shocker': though unfortunately the situations opened up are usually left unsettled and mayhap, even when 'continued in our next,' will still remain problematical The plot, in fact, is seemingly one of fearful complexity and the detectives engaged in unravelling the story have been far from possessed of the logical training and mental agility needed to dissect out its many threads: still, that definite pathways are being cleared through the maze cannot be doubted.

The book is most happily dedicated, by the authors, to Prof. H. B. Dixon, of Manchester, whose school is responsible for the greater part of the English work which is described The issue he raised in 1880, while but a reader in Oxford, in showing that carbonic oxide was rendered incombustible even by moderate drying, underlies the whole narrative and remains unsettled to the It seems to be a Snark that cannot be caught—pursue it as we may and rouse it even with the high potentials the electrician of to-day has placed at our disposal, not merely with jam and judicious advice, this last being perhaps the least acceptable to its non-conformist nature. Carbonic oxide is the most elusive customer we have in chemistry.

Facing the title page, the authors most appropriately quote the passage from Carlyle's "Hero as Divinty," one of the most characteristic of his essays, ending with the words, "From us too no Chemistry, if it had not Stupidity to help it, would hide that Flame is a wonder. What is Flame?" They carefully withhold the answer but, reading between their lines, we can see fairly clearly what a wondrous amount of stupidity has been displayed in seeking one: in fact, a large part of the book is a veritable comedy of errors. A deal of sack with very little bread. A wealth of experimental skill

is displayed but backed by a parlous deficiency of acute theoretic dissection.

Our science and our music seem indeed to be in similar quandary and but muddle through. Concertos are not concerted. Players are not playing their parts in the orchestra with effect, because of the lack of common rehearsals and the absence of skilled conductors. Verily is chemistry, at present, nought but an empiric art. We cannot be too grateful, therefore, to the authors for having set forth the evidence so clearly. If not all, they have put most of their cards upon the table and thereby challenged us to play them it is for us to take as many tricks as we can and they must not squeal if we are found to hold the trumps: frankly, their hand is a rotten one, their theory worse than threadbare

The purpose of the book is a review of the principal inquiries into the phenomena of combustion, from the time of Robert Boyle onwards to the present day, more particularly those of the period dating from about 1880, when Mallard and Le Chatelier and Berthelot and Vielle, in France, began the study of explosive combustion and were followed, in England, by H. B. Dixon, Smithells, Lewes, Dugald Clerk, Bone and his pupils and others. As the principal landmark in the survey is Dixon's theatrical discovery, over which we are still disputing, the period may well be spoken of as the carbonic oxide period. Of the five sections into which the work is divided, the first is introductory and historical, a brief but interesting survey of the work done mainly before 1880; in this, of course, Davy's and Bunsen's primary contributions are specially considered. The subjects discussed in the remaining four sections are:

- II. The Initiation and Development of Flame and Detonation in Gaseous Explosions (chaps. viii. to xviii.).
- III. Gaseous Explosions in Closed Vessels (chaps. xix. to xxiii.).
- IV. The Mechanism of Gaseous Combustion (chaps. xxiv. to xxxiii.).
- V. Catalytic and Incandescent Surface Combustion (chaps. xxxiv. to xxxvi.).

The work is profusely illustrated and contains a number of very beautiful photographs, showing the propagation of explosive waves, reproduced from Prof. Bone's communications in the *Proceedings of the Royal Society*. For the first time, an opportunity is given of appreciating the inventive skill and ability of the workers of the school which he has so happily called into being at South Kensington.

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If we are ever to acquire ment by securing theoretic command of the internal combustion engine, we must understand the so-called mechanism of combustion—hitherto, our treatment of the subject has been soulless. The authors deal with it at length but perfunctorily, particularly in discussing the combustion of carbonic oxide and of hydrocarbons. It is my fate to figure as the villain in the piece First, under carbonic oxide (p. 337), as follows

"H. E. Armstrong, who always contends that chemical interactions cannot occur between two perfectly pure substances but require an electrolyte to form a 'closed conducting circuit,' supposed that the presence of steam, which he regards as being rendered conducting by association with some traces of an electrolytic impurity, provides the necessary conditions for the passage of the current, the oxygen playing the part of depolariser, as follows:

"According to this view, the molecules of oxygen and a combustible gas are in all circumstances absolutely inert towards each other. Indeed, quite recently, Armstrong declared carbon monoxide to be 'per se an incombustible gas,' adding that 'an explanation may be found in the assumption that when a moist carbon monoxide mixture is sparked or fired some hydrone is decomposed and sufficient hydrogen set free to act in a depolarising circuit together with the oxide, as thus:

H HO...H O H
H HO...H O H
HOH
HOH
$$+ \cdot \cdot \cdot + \begin{bmatrix} HO & H \\ HO & HO \end{bmatrix} O : C \longrightarrow HOH$$

$$+ \cdot \cdot \cdot + \begin{bmatrix} HO & H \\ HO & HO \end{bmatrix} O : C$$

$$= HOH + HO \cdot O : C$$

$$= 2H_{0}O + CO_{0}.$$

"This is perhaps the most elaborate and extreme form which any chemical explanation has hitherto taken, although all of them involve the assumption that in the combustion of carbonic oxide steam is continuously decomposed and regenerated."

Again, under hydrocarbons:

"Another alternative, namely, that the initial stage of the oxidation of a hydrocarbon might conceivably involve the transient formation of an unstable 'oxygenated' molecule, which, according to circumstances, would decompose more or less rapidly under the influence of heat, giving rise to simpler 'intermediate' products, had been suggested by H. E. Armstrong but never explored experimentally For on p. 417 of a new edition of Miller's 'Organic Chemistry,' published in 1880,

he had visualised such oxidation processes as primarily involving 'hydroxylation.' In our next two chapters, we shall see how this idea ultimately furnished a solution of the problem."

The issue to-day, as the authors recognise, is whether water be *essential* to the process of combustion.

On this first count I am said to come out badly, because I have 'ignored' "that there are well established cases (cyanogen, carbon bisulphide) in which apparently [I like the caveat and take it as evidence of a latent, uneasy conscience in the writers] combustion does not depend upon the presence of moisture." Also, because "any chemical view postulating that carbonic oxide cannot be burnt in flames except by the intervention of steam, which is continually decomposed and regenerated in the process, is countered by the spectroscopic evidence." One might use Mantalini language about spectroscopic evidence. I will only say: it leaves me cold; mercury, for example, as is well known, may be present in relatively large amount in a vacuum tube and yet be neither seen nor heard in the spectrum of the discharge. Carbon bisulphide is probably one of the liquids that is impossibly difficult to dry. The cyanogen used may even have been Bone-dry but no proof has been given that it was free from hydrogen cyanide. Go to, friend Bone, your 'well-established cases' may well go hang.

> "Nay, an thou'lt mouth, I'll rant as well as thou."

You, in your turn, ignore the prime fact, that the heat of combustion of carbonic oxide is below that of hydrogen; also—as shown by Grove—that carbonic oxide cannot be substituted for hydrogen, in the gas cell. It cannot, therefore, be oxidised by steam.

These are two nasty little facts which rather spoil your speculation: it hasn't the ghost of a theory about it. Your Bone-dry gas, after all, was not yet dry. Drying is an equilibrium process: some moisture will have been left upon the surfaces enveloping the gases. A vast amount of 'punch' has to be put into the discharge to get it through and yet combustion is far from complete. What happens when and as the discharge gets through? Is it not almost certain that hydrogen, imprisoned in the platinum electrodes and also platinum motes, are extruded into the gas? The photographs show that the explosive wave only 'gets up steam' gradually. As combustion is set up less and less readily as drying proceeds, drying being never complete, is it logical to assume that

another second process comes into play towards the end rather than that that initially in operation is dying out? The efficiency of your supposedly 'dry' process is so low, moreover, that the idea is not worth even provisional protection. No Comptroller could or would pass such a claim to an invention.

"Tempted by extremes,
The soul is most secure:
Too vivid loveliness blinds with its beams
And eyes turned inwards perceive the lure."

"Who seeks the shadow to the substance sinneth."

The fact is, we have reached the limit to which experimental inquiry into such an issue can legitimately be carried. We need to sit down and calmly and logically worry out all consequences of the observations on record: to call a constructionholiday—even engage Lord Cecil to 'disarm' our laboratories for a time and force workers to put on thinking-caps. We are in danger of making a fetish of laboratory work—the more since literary men have assumed control of the funds devoted to inquiry. The experimenter is apt to think too much of himself—to suffer from Cephalitis enlargica. He puts in his thumb and pulling out a plum thinks that he has, therefore, the right to say: 'What a good boy am I.' More often than not, he is a bad boy: the plum is a poor thing, unripe and sour; such plums should never have been made into a pie. This is particularly true in the field of biological inquiry. To experiment usefully, the motive of the experiment must be first visualised and must be logically conceived: its purpose must be clear and it must be carried through and the results punctiliously recorded and judicially interpreted with logical precision. These several ingredients are rarely present and mixed in due proportion in the research pie, nor is sufficient experience and intelligence imported into the operations.

The true art of scientific inquiry is the outcome of genius and acquired only by the few: no attempt is made to teach it, in any considered way. We have to change all this, beginning in the schools. We shall do well to stay experimenting for a time and call in competent accountants—if there be such—to take stock for us and balance our books. We may then realise how ragged a state our business is in and how necessary it is to reorganise it. Our subject is very much in the condition of certain large firms that have recently lapsed into inefficiency through incompetent management. We shall certainly find that much of our stock is worthless and need to scrap a lot. We shall be in a position to say what new stock is

most needed. What is good of that we have will make a brave show, when displayed apart from the rubbish with which it is now mixed. The book under notice shows this but also a lot of tares mixed with the wheat. Let us frankly admit that much of the work that is attempted to-day is too difficult for those who undertake it:

"For, although common Snarks do no manner of harm, Yet I feel it my duty to say, Some are Boojums——"

Passing to the second count, on which I win, as the authors magnanimously admit, I have a bone to pick with them on the ground of historical accuracy: I am an older sinner than they suggest. If they will turn to the first edition of my "Organic Chemistry" (Longmans), published in 1874, they will find on p. 216, under Aldehydes, a statement that these are probably formed from alcohols as the result of two distinct changes, the first being "the production of a compound of the form R'. CH(OH)(OH), which is subsequently broken

R'. CH(OH)(OH), which is subsequently broken up into the aldehyde and water, the former of these changes being brought about either (a) by the direct addition of oxygen to the alcohol or (b) by the combined influence of the nascent oxygen and water or (c) perhaps by the agency of hydroxyl (hydric peroxide  $(OH)_2$ ) itself, thus:

$$\begin{array}{lll} (a) & R' \cdot \operatorname{CH}_2(\operatorname{OH}) + \operatorname{O} & = R' \cdot \operatorname{CH}(\operatorname{OH})_2 \\ (b) & R' \cdot \operatorname{CH}_2(\operatorname{OH}) + \operatorname{O} + \operatorname{OH}_2 = R' \cdot \operatorname{CH}(\operatorname{OH})_2 + \operatorname{OH}_2 \\ (c) & R' \cdot \operatorname{CH}_2(\operatorname{OH}) + (\operatorname{OH})_2 & = R' \cdot \operatorname{CH}(\operatorname{OH})_2 + \operatorname{OH}_2 \\ & R' \cdot \operatorname{CH}(\operatorname{OH})_2 = R' \cdot \operatorname{COH} + \operatorname{OH}_2. \end{array}$$

I applied the 'hydroxylation' explanation throughout the rest of the book and, afterwards, in rewriting Miller's "Organic Chemistry," published in 1880. I may add that I began the study of flame in March 1867, when I first attended a course at the Royal Institution and heard Frankland's lectures on coal gas, in which he disputed Davy's explanation of the luminosity of flames.

The "never explored experimentally" in the quotation before given has an ungenerous twang. In framing my doctrine, I had before me the whole of the evidence bearing upon the 'hydroxylation' process accumulated up to that time: it was considerable. The work done by Prof. Bone and his fellow workers is of value and importance, as showing the character and course of the changes under these or those particular conditions: not as special evidence of 'hydroxylation.' Drugman's observation, a most important one, that ethylic alcohol may be obtained directly from ethane with the aid of ozone, is the only direct demonstration to be derived from the inquiry, in justification of the view I have long held and advocated, that

oxidation, in the first instance, invariably involves hydroxylation

The intensity of my behef is due to the firmness with which I hold the faith, that every chemical interaction is electrolytic in its origin and in its course and that the interactions in the Grove gas cell are to be taken as prototypical of all combustions. They are summarised in the expression:

The authors have yet to learn that "faint love never won fair lady." They are not 'real sports.' If they were they would not hedge by saying of the "hydroxylation theory, advanced more than twenty years ago" (sic, 1880–1927 = 47, alternatively 1874–1927 = 53):

"It should, however, not be interpreted or applied too rigidly, because doubtless in the long run the steady accumulation of new facts will necessitate some modifications and it would be unphilosophical to regard it as more than a serviceable tool for accomplishing further advances. It certainly affords what we believe to be a true explanation of slow combustion."

The authors have their doubts as to its application to flame. The fact is, they have not yet learnt how to apply it. Their oxidation schemes are but skeleton forms—the intimate process is not considered. They visualise thermal changes as intermediate operations. Formaldehyde is figured as just breaking down into hydrogen and carbonic oxide:  $CH_2O = CO + H_2$ . My sheet anchor has always been the belief in the superior charm first exercised by the oxygen atom and I would picture the downfall of formaldehydrol as a complex process, involving both hydroxylation and hydrolysis, at least in part often ending as shown schematically by the expression.

$$\begin{aligned} \mathbf{H}_2 \mathbf{C}(\mathbf{OH})_2 + 2(\mathbf{OH}) &= \mathbf{H} \mathbf{H} \mathbf{C}(\mathbf{OH})(\mathbf{OH}) \\ \mathbf{OH} \\ &= 2 \mathbf{H}_2 \mathbf{O} + [\mathbf{C}(\mathbf{OH})_2 = \mathbf{CO} + \mathbf{OH}_2)]. \end{aligned}$$

Carbonic oxide, in like manner, is the product of the hydrolysis of chloroform by caustic soda. If the CH<sub>2</sub> hydrogen were displaced by hydroxyl, formic and carbonic acids would be the products. In this instance, in my opinion, the hydrogen is quietly 'pulled away' by hydroxyl. The production of carbon from acetylene as well as that of hydrogen from formaldehyde, are also complex, not 'purely thermal' effects, I am satisfied.

At the close of 1891, the late Sir George Stokes

did me the honour to criticise an address of mine to the Junior Engineering Society. We discussed together the interactions occurring in flames. One of my points was that purely thermal changes were unlikely to occur. My attitude was then as conservative as my ignorance was great but all that has happened in the interval of thirty-five years justifies the final plea in my letter (Chemical Society's Proceedings, 1892, 22-27).

'Regarding the interactions in flames as consisting in a series of simultaneous and consecutive explosions, of which we can only examine the final steady state, it seems to me that the phenomena are necessarily of an excessively complex character and that their appreciation and successful interpretation must tax our powers of mental analysis in a very high degree. It will certainly be unwise at present to infer that the oxidation of the hydrocarbons or the separation of carbon and also of hydrogen from them, takes place entirely in any one way.'

The number of successive interactions involved in an oil engine explosion is almost incalculable, yet there can be little doubt as to their general course. It is impossible here, however, to discuss the subject at the length that would be necessary. The one point I desire to make is, that we not only need accurate experiment but also acute criticism of the results—what we get is worthy only of the nursery, not of the Senate House.

The book under review will have failed in its mission if it have not as result a searching examination of its many propositions.

HENRY E. ARMSTRONG.

### Science and Religion.

- Evolution in Science and Religion. By Robert Andrews Millikan. (Published on the Dwight Harrington Terry Foundation.) Pp. v + 95.
   (New Haven, Conn.: Yale University Press; London. Oxford University Press, 1927.)
   4s 6d. net.
- (2) Science and Human Progress. (Halley Stewart Lectures, 1926.) By Sir Ohver Lodge Pp. 187. (London: George Allen and Unwin, Ltd., 1927.) 4s. 6d net.
- 1) BOOKS about the relation between science and religion are apt to be heavy, but this reproach certainly cannot be levelled against Prof. Millikan's little volume. He gives in a few brilliant pages a sketch of the remarkable change which has come over the modern physical interpretation of the universe. He has been well placed to observe this change, having been, as he tells us, in direct touch with the older masters of the classical physics and

having watched step by step and participated in the revolution which was initiated by Rontgen's discovery of the X-rays. He attended Rontgen's first demonstration on Christmas Eve, 1895 · "As I listened and as the world listened, we all began to see that the nineteenth century physicists had taken themselves a little too seriously, that we had not come quite as near sounding the depths of the universe, even in the matter of fundamental physical principles, as we thought we had " (p. 10).

This gives the key-note of Prof Millikan's book, and most of it is a commentary, well documented, on the dangers of dogmatism both in science and in religion. His remarks about the shortcomings of the classical materialistic conception of the universe are amazingly frank "We can still look," he writes, "with a sense of wonder and mystery and reverence upon the fundamental elements of the physical world as they have been partially revealed to us in this century The childish mechanical conceptions of the nineteenth century are now grotesquely inadequate" (p. 27). Prof Millikan has all the enthusiasm of the experimentalist, looking to the continued advance of experimental science for the future progress of humanity. He has a firm belief in progress as "the most sublime, the most stimulating conception that has ever entered human thought"; one respects the belief and its stimulating power, even though it may be, as he admits, an illusion, but one cannot help thinking that if progress be merely "the increasing control over environment," something else is required to make human life fuller, more adequate, and happier.

Prof. Millikan's third lecture on "The Evolution of Religion" is scarcely so good as the other two—those entitled "The Evolution of Twentieth-century Physics" and "New Truth and Old"—but English readers will note with interest his view of the Scopes trial. While recognising the menace to freedom of thought implied in fundamentalism, he is inclined to think that the Scopes trial has done more good than harm, by ventilating the problems and making people think.

With Prof. Millikan's conclusions, as summarised in the following passage, few, we imagine, will disagree.

"Physics," he writes, "has at the present moment something to teach to both philosophy and religion, namely, the lesson of not taking itself too seriously, not imagining that the human mind yet understands, or has made more than the barest beginning toward understanding the universe. To-day physics is much more open-minded, much less dogmatic, much less disposed to make all-

inclusive generalisations, and to imagine that it is dealing with ultimate verities, than it was twentyfive years ago. This generalising farther than the observed facts warrant, this tendency to assume that our finite minds have at any time attained to a complete understanding even of the basis of the physical universe, this sort of blunder has been made over and over again in all periods of the world's history and in all domains of thought. It has been the chief sin of philosophy, the gravest error of religion, and the worst stupidity of science -this assumption of unpossessed knowledge, this dogmatic assertiveness, sometimes positive, sometimes negative, about matters concerning which we have no knowledge. . . . If there is anything that is calculated to impart an attitude of humility, to keep one receptive of new truth and conscious of the limitations of our understanding, it is a bit of familiarity with the growth of modern physics '

(2) The same lesson is taught by Sir Oliver Lodge in his Halley Stewart lectures. He also emphasises the great significance for all branches of thought of the revolution in physical concepts which the "younger heretics" enthusiastically support. Everything has been put into the melting-pot, and the creed of science is being reconstituted. With it all. Sir Oliver pleads for a return to simplicity in matters of everyday conduct and experience, to the common-sense view of life, in accepting which the wayfaring man, though a fool, does not err. His lectures, which cover a wide field of practical philosophy, are, we need scarcely say, distinguished by that genius for simplicity of exposition which make them so understandable of, and so useful to, the man in the street. He emphasises, as does Millikan, the danger of dogmatism in any form and the need for freedom and fluidity of belief.

Ultimate philosophy is to some extent a matter of personal conviction and experience; for this reason we do not propose to comment upon Srr Oliver Lodge's acutely dualistic scheme of things further than to express the contrary opinion that a more satisfactory philosophy is contained in the 'organic' view of reality put forward with such skill by Prof. Whitehead.

E. S. R.

## The Soil and Civilisation.

Soil and Civilisation: a Modern Concept of the Soil and the Historical Development of Agriculture. By Milton Whitney. (Library of Modern Sciences.) Pp. x+278+5 plates. (London: Chapman and Hall, Ltd., 1926.) 15s. net.

THE concept that the author sets out to develop is that "the soil is not the dead, inert, and simple thing often referred to as 'dirt.' It is No. 3021, Vol. 1201

essentially a factory where raw materials are converted into finished products" In other words, the soil must now be regarded as dynamic rather than static, as indeed a living thing having complicated functional activities that react on one another and affect its productive power in the growth of plants. As a logical result, the man who understands his soil and treats it with sympathetic consideration of its individual peculiarities is in a position to get far heavier crops than he who fails to appreciate the possibility of this co-operation between soil and man. It now seems probable that the soil has a regenerative power that will enable it to produce crops indefinitely, subject to the application of knowledge and skill in its working, instead of being liable to become worked out and exhausted unless a supply of plant food elements, such as phosphorus and potash, is returned in amount equivalent to that removed by the crops

An attempt is made to draw an analogy between the soil and the animal, in view of the concept of the soil as a living entity. The various soil types are illustrated by accounts of the important soils of the United States, indications being given of the crops that are best adapted in each case, with the reasons for this association A proper balance is necessary between what are termed the respiratory, circulating, and digestive systems of the soil for any particular crop to succeed. Methods of soil control are not confined to the replacement of plant food abstracted by crops, but include the proper rotation and adaptation of crops, suitable methods of cultivation, irrigation and drainage, and adequate balancing of organic and chemical manures. After discussion of the conception of the rôle of manures in ancient and modern agriculture, Whitney claims that the time has come to drop the term "plant food" as applied to fertilisers, and pleads for the recognition of the significance of the biochemical factors of the digestive system of the soil and the interdependence and the correlation which exist for the best effort of the soil, the plant, and the fertiliser treatment. In the earlier days of agriculture the responsibility for the maintenance of productivity in the fields rested entirely on the man, but even nowadays chemical fertilisers are not a substitute for human endeavour; they are simply a means of aiding to maintain agriculture in an economic position.

In the cycle of ages, most civilised countries have developed well-organised agricultural systems, many of which have since died out. The cause of this often lay in a change in the character of the people, a substitution of nomadic for sedentary



races, as in Asia Minor and Mesopotamia. Engineering works and irrigation systems were essential for the life of agriculture, and failure to maintain these was often the result of political changes, as in Spain after the conquest. In countries where agriculture has survived, no wars of extermination have occurred. China and Japan have maintained the productivity of their soil by sheer hard work, whereas in Egypt the natural irrigation and increased fertility due to the Nile cannot be de-The agricultural literature of the Romans shows that though the soil was never very productive, intelligence was brought to bear upon cultivation with profitable results The first 1500 years of the Christian era represent the Dark Ages, during which constant warfare precluded agricultural development. After Jethro Tull's advent in 1701 a gradual improvement set in in England, as well as in France and Germany.

Present-day agricultural practice has not advanced greatly over that of the ancients, but more knowledge of material things has been acquired in the last century, as of steam, electricity, chemical elements, etc., and a beginning made in their application. It remains to be seen how the new discoveries will be used. There is every reason to believe we have made only a beginning in the possibilities of research, and it is not outside the bounds of possibility that improvement in important farm crops, as wheat, corn, oats, cotton, may yet be made more commensurate with the development already achieved in animals, in orchard fruits and garden vegetables, by means of intelligent application of the principles of science to agriculture. W. E. B.

# The Analysis of the Reflex.

Muscular Contraction and the Reflex Control of Movement By Dr. J. F. Fulton. Pp. xv+644. (London: Baillière, Tindall and Cox, 1926.) 45s. net.

"Integrative Action of the Nervous System" marked the beginning of a new epoch in neurology. Until then attention had been centred mainly on the analysis of the central nervous system into its anatomical components, the fibre tracts, and nuclei. Their different functions were investigated but very little was known of the way in which these functions were carried out. Sherrington used an entirely different method, the analysis of the complex behaviour of the organism into its component reflexes. Taking the reflex as the basic reaction of the central nervous system, he showed how the

reflexes are compounded and adjusted to make up the changing pattern of activity which we see in the organism in its natural surroundings.

The analysis of the activity of the central nervous system into the constituent reflexes is and must remain for a long time the most potent method of neurological research; but it was clear that the analysis could be pushed a stage further, for the reflex itself is not an irreducible unit but is made up of a complex of activities in the nerve fibres, synapses, and muscles. Not long after Sherrington's book had focussed attention on the reflex, Keith Lucas began an attempt to work up to the reflex from the unit reactions of the nerve fibre. This work was cut short by the aeroplane accident which deprived physiology of one of its most powerful investigators, but its influence has been far-reaching, and in recent years there has been an increasing tendency to analyse the reflex into the simple reactions of muscle and nerve along the lines which Lucas suggested. This tendency is reflected in the present book, which is written by a pupil of Sherrington's on the basis of work carried out at Oxford during the past four years.

To some extent Dr. Fulton works at a disadvantage, in that there is no very clear picture to present. Much work is still in progress on the physiology of the muscular contraction and of the nervous impulse, and although we can see a good way into the processes involved in the activity of the nerve and muscle fibres, we are still in the stage of collecting information and modifying our hypotheses to suit each new piece of evidence. For this reason there is much that is bound to be speculative in Dr. Fulton's presentation of the facts of muscle and nerve physiology, as, for example, in his discussion of the latent period, the summation of contractions, the neuro-muscular junction, etc. There is still more uncertainty when we come to build up a picture of reflex activity out of what is known of the simpler reactions of nerve and muscle. We are still in the throes of a controversy (very well handled by Dr. Fulton) on the nature of the tonic contraction and the relation of the sympathetic system to it, and we have not advanced beyond the stage of multiple hypotheses on the subject of central inhibition. But for all that, the position is clearing rapidly. We know what goes into the central nervous system and what comes out of it, the messages from the sense organs and the messages to the muscles. In every case the message consists of a series of nervous impulses of the type made familiar by investigations on the isolated nerve fibre, and the recent work in Oxford has done much to suggest how the incoming and the outgoing messages are related to one another in the central nervous system.

Although the time is scarcely ripe for the presentation of a complete survey of reflex activity, Dr. Fulton is certainly to be congratulated on the orderly and readable account he has made, both of his own researches and of the great mass of recent work on the many fields involved. Any one who is concerned with the physiology of movement, whether as an investigator, a teacher, or an examinee, will find this book a most valuable (though expensive) collection of recently acquired facts and theories. There is an interesting historical introduction which does not omit due reference to Aristotle, and the book is closed by a table of more than 1000 references. In these days it is hard to overestimate the value of a comprehensive review of this kind, and Dr. Fulton deserves high praise for writing it.

# Our Bookshelf.

The Composition and Distribution of the Protozoan Fauna of the Soil. By H. Sandon. (Biological Monographs and Manuals, No. 7.) Pp. xv + 237 + 6 plates + 3 charts. (Edinburgh and London: Oliver and Boyd, 1927.) 15s. net.

The study of parasitic Protozoa received an immense impetus at the beginning of the century by the increase in our knowledge of certain forms, especially Hæmosporidia and trypanosomes, which are of vast importance in relation to disease of man and animals. In a corresponding manner, the subject of soil protozoology may be said to have been re-born early in the second decade by the work of Russell and Hutchinson and their followers on Protozoa in relation to sick soils. While, however, it is not yet agreed to what extent the Protozoa are, indeed, responsible for diminution in soil-productivity, nevertheless, a new field of protozoological knowledge has been tilled and sown, and some good first-fruits are garnered in this volume.

As Prof. J. H. Ashworth points out, in a specially written foreword, the taxonomic position of the subject can be regarded as already fairly satisfactory, with a record of some two hundred and fifty described species. Two or three new generic or specific names are here created, although this practice in a book is, from the point of view of a recorder, to be deprecated. Under the different classes, the author gives helpful keys for the identification of the various forms, but, as he recognises, in one or two cases, the criteria adopted are to be used with circumspection. In connexion with the account of geographical distribution, the interesting, almost ubiquitous range of many of the species is well indicated by means of tables at the end knowledge respecting the ecology is still disappointingly limited. After discussing the various factors which may influence the numbers and characters of

the protozoan population of the soil, Sandon concludes that none of the climatic or soil conditions considered is capable of explaining adequately the relative abundance of Protozoa in different soils

The book is well arranged and attractively produced, and six plates of figures of characteristic soil Protozoa are given. While, of course, no claim to finality is made for the volume, it is a distinctly needed and useful compendium for those interested in this important subject. H. M. W.

Stories in Stone. Telling of some of the Wonderlands of Western America and some of the Curious Incidents in the History of Geology By Willis T. Lee. (Library of Modern Sciences) Pp xii + 226 + 49 plates. (London: Chapman and Hall, Ltd., 1927.) 15s. net.

The author of this entertaining and beautifully illustrated book did not live to see its publication, but he has left behind him a record of picturesque experience and eloquent enthusiasm. Dr. Lee's work lay largely amongst the extravagant scenery of the western of the United States; while in later years he assisted in the exploration of the great Carlsbad Cavern, and began the study of landscapes from the air. The book reflects a corresponding love for the colourful and spectacular, and in an informal and non-technical way it succeeds in imparting not only the romantic spirit of geology but also a good deal of sound knowledge.

The Grand Canyon is selected as the point of departure because it introduces rocks of the Other pages of earth history are earlier eras. written round the Painted Desert and Petrified Forest of Arizona; the high plateaux and Vermilion Cliffs of Utah; the ice-scuptured Yosemite Valley; and the impressive peaks of the Rocky Mountain National Park. Many of the illustrations are reproductions of photographs taken from the air, and the book as a whole is original in both manner and matter. Teachers of geography will find in it many a telling example, and though its appeal will necessarily be mainly American, it can be cordially recommended to the layman who is looking for a brightly written interpretation of landscape and earth history.

Physiology and Biochemistry in Modern Medicine. By Prof. J. J. R. Macleod; assisted by Roy G. Pearce, A. C Redfield, N. B. Taylor, and J. M. D. Olmsted, and by others. Fifth edition. Pp. xxxii + 1054 + 9 plates. (London: Henry Kimpton, 1926.) 42s. net.

WITH the advance of any science the tendency to specialisation becomes greater and its relationship to, or applications in, other branches of knowledge may be missed unless investigators and teachers can take a very wide view based on facts culled from sciences with which, perhaps, they are not immediately acquainted. Thus the application of physiology to medicine requires an acquaintance with both sciences, which is difficult to maintain when both are advancing rapidly. The aim of Prof. Macleod's book has been to supply the student of medicine with an up-to-date account of the more

important facts of physiology, more especially those which have a direct bearing on the practice of medicine. In this, the fifth, edition the text has been somewhat expanded, so that the work may be used also as a text-book of physiology by the medical student. Dr. Olmsted has added a section on the special senses, and Dr. Redfield has expanded his section on the neuro-muscular system. The application of the latter subject may not at present be apparent in the investigation of disease, yet it is certain that it exists, and it can only be made when the clinician has become familiar with the very latest work. For the medical student or for the practitioner of medicine the book should prove invaluable, whilst for the research worker, further information can be found from the selected references given at the end of each part.

Supplement to an Introduction to Sedimentary Petrography: with Special Reference to loose Detrital Deposits and their Correlation by Petrographic Methods By Henry B. Milner Pp. 156+plates 17-28 (London: Thomas Murby and Co., New York: D Van Nostrand Co., 1926) 9s. 6d. net.

RECENT activity in the study of the mineral composition and derivation of sediments has induced the author, who has given special attention to the subject for many years, to give forth in the form of a supplement to his "Introduction to Sedimentary Petrography," a record of work done since the issue of that book in 1922 The new matter relates to methods of examination as well as to mineral descriptions, the latter including twenty minerals additional to those previously described. The two volumes cover descriptions of seventy-four minerals, fifty of which are illustrated. The illustrations are partly reproductions of washdrawings by G. M. Part and photomicrographs by G. S. Sweeting, all of which are excellent and make a very attractive feature. The supplement contains three appendices, the first of which gives tables for the determination of detrital minerals. The second appendix gives a list of rock-forming minerals which have not yet been recorded as occurring in sediments, but may be expected to be found as the result of further investigation. The third appendix gives a short but excellent and up-to-date bibliography, which is perhaps the most useful feature of the book.

Van Nostrand's Chemical Annual: a Hand-Book of Useful Data for Analytical, Manufacturing and Investigating Chemists, Chemical Engineers, and Students Edited by Prof. John C. Olsen; assistant editor, Dr T. R. Le Compte Sixth issue, 1926. Thoroughly revised and enlarged. Pp xv+882 (London: Chapman and Hall, Ltd., 1927.) 21s net.

Among the many new tables that have been included in this, the sixth, issue of this quadrennial compendium of numerical information, are those of isotopes, hydrogen-ion concentrations, isoelectric points of proteins, vapour pressures of hydrated salt systems and detailed properties of

lead and mercury. The general features of the volume remain unaltered; revision and correction have been effected where necessary, notably wherever the atomic weight of antimony is involved.

Comprehensive as are the lists of physical constants of compounds, one or two of the more recent commercial products have been overlooked, and certain of the organic compounds retain their German spellings. It is questionable whether the inclusion of a large number of problems, so reminiscent of very early examination days, is justified in a work of this character, although the illustrative discussions in this section ("Stoichiometry") are most useful. So far as is practicable, reference is made to original sources of information. Care must be exercised in using tables involving gallons and Beaumé scale, since the book reflects American practice.

Arrhenius is the notable man of science who figures as frontispiece for this issue. B. A. E.

Islands near the Sun: Off the Beaten Track in the Far, Fair Society Islands. By Evelyn Cheesman.
Pp. 236+9 plates. (London: H. F. and G. Witherby, 1927.) 12s. 6d. net.

A FEW months in the Society Islands gave Miss Cheesman opportunities of seeing Tahıti, Raiatea, and Bora Bora, and her experiences and observations are recorded in this delightful volume. It differs from most books on the South Sea Islands in describing not merely the well-populated coast regions, but also the less visited high ground of the interior. Miss Cheesman's main object was to study the insect life of the islands, which was not well known before her visit, and while insects loom large in her pages, she misses nothing of interest in natural history. The book, in fact, is a record of a naturalist's wanderings, written with considerable descriptive power and much appreciation of the beauty of the islands. It is illustrated by a few photographs and sketches by the author. Among the many books on Tahiti it deserves to take a prominent place. There are appendices which give a catalogue of the fauna.

The British Hydracarina. By Chas. D. Soar and W. Williamson. Vol. 2. (Ray Society volume (No. 112) for the Year 1926.) Pp. viii + 215 + plates 21-40. (London: Dulau and Co, Ltd., 1927.)

THE authors are to be congratulated on the completion and issue of this second volume of their monograph so soon—within a couple of years—after the first. This volume is devoted to the systematic description of the water mites of the family Hygrobatidæ. The characters of the ten subfamilies, of the eighteen constituent genera and of the species are carefully defined, with the help of a liberal supply of excellent illustrations These form plates xxi-xl of the work; the first six plates are in colour and all are well reproduced Under each species is given a note of the localities where it has been taken in Britain, and the more general distribution of the species in other parts of the world is indicated by mentioning the countries in which it is known to occur.

# Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

### The Sources of Supply of Vitamins A and D.

The problem of an adequate supply of the fatsoluble vitamins for the needs of the growing population has received prominent attention at the recent meeting of the British Association. The shortage in the supply of milk fat in particular was emphasised, and a simple calculation led to the conclusion that this shortage is not a local one in Great Britain, but of world-wide extent. Butter is irreplaceable by margarine as long as this article of diet is deficient in vitamins. Even if we do not share the gloomy view as to the effect of this shortage on the health of the nation, since milk fat is not their only source, it must be admitted that the problem of the supply of fatsoluble vitamins is of outstanding importance.

We would like to direct attention to the outcome of recent researches, only partially published as yet, in the course of which we became aware of easily accessible sources of both vitamins A and D. The solution of the problem depends now only on the industrial application of the knowledge made available by such

research.

So far as vitamin A is concerned, we found that the chromogen responsible for the arsenious chloride colour reaction, discovered by one of us (O. R.), is present not only in the liver of the cod, but also in the livers of all animals examined, fishes, birds, and mammals. A study of the quantitative distribution of this chromogen and its correlation with vitamin A by means of the biological growth-test (Lancet, n. 806; 1926), proved that the amount present in other liver fats in many cases far exceeds that found in cod-liver oil, the richest source of vitamin A previously known. It must be remembered that the main reason for the selection of the cod as a source of medicinal oil, leading to the development of the cod-liver oil industry, was the extraordinarily high fat content of the cod's liver and its relatively easy extraction on a commercial As regards vitamin A content, however, we found that the liver oils of other fishes, such as salmon or halibut, are often more than 100 times as rich as cod-liver oil.

On account of their limited accessibility, these oils cannot be considered as a commercial source of vitamin. The same reason excludes the liver fats of birds, some of which, such as those of the grouse. goose, fulmar petrel (*Biochem. Jour.*, 111; 1927), are extremely potent. The liver fats of herbivorous mammals, on the other hand, appear to be an ideal source of vitamin A. These animals live mainly on green fodder, the original source of vitamin A, and accumulate a store of it in the liver, as do fish and birds. We found by both colorimetric and biological tests that the hver fats of sheep, calf, and ox contain on the average as much as ten times the amount of vitamın A as a good Newfoundland cod-liver oil. Taking the vitamin A content of butter—a very variable factor—as from 1/20 to 1/100 that of cod-liver oil, these fats may be said to be from 200 to 1000 times more potent in this respect than butter. A recently published letter (see Times, Sept. 7) shows that by an interesting coincidence our results in this respect are confirmed by the independent observations, hitherto not published in detail, of Prof. Wilson, formerly of Cairo. According to these, "the liver fats of Egyptian sheep and oxen appear to contain about 200 times the amount of vitamin A found in the best butter examined Without entering into a calculation of the available supply of liver, we may assume that Great Britain's need is easily met at home, supplemented if necessary by Empire produce It may be stated that the vitamin content of the fat obtained from imported New Zealand liver equalled that of the liver of home-killed animals

As an additional advantage for the purpose suggested, we find that these fats are free from the objectional flavour of fish oils, which is apparently connected with the presence of the highly unsaturated clupanodonic acid ( $C_{22}H_{34}O_2$ ) and the Fearon colour reaction (*Biochem. Jour.*, 1342; 1926) Owing to their low melting-point, liver fats can be easily incorporated with other fats, such as margarine. Although easily extracted by the use of fat solvents, their isolation would probably not be necessary in large scale manufacture. Vitamin A, being fat-soluble, can be directly extracted from the tissue by a neutral oil. The wellknown skill of the margarine manufacturer should enable him so to incorporate the liver fats with his product as to convert a dietary article, already identical with butter in calorific value, into a cheap and palatable product of equal biological efficiency, so

far as vitamin A is concerned.

The no less important vitamin D, another variable constituent of butter, remains to be considered. Contrary to the expectation that this would also be contained in the mammalian liver fat, we found that the liver fat of sheep, at any rate, is practically devoid of this vitamin. It would seem that, unlike fish, the herbivorous mammal does not store vitamin D in the liver. On the other hand, the body fats of certain fishes, although free from vitamin A, as tested both colorimetrically and biologically, were found to be a good source of vitamin D. An interesting exception to what appears to be a general rule was revealed in the examination of the body oil obtained from eels. The oil content of this fish is relatively high (about 30 per cent ), and it contains not only vitamin D, but also vitamin A in an amount nearly equal to that of some Norwegian cod-liver oils (tested colorimetrically and controlled by the animal test). This result confirms, medentally, the high value empirically attributed to the eel as an article of diet.

There is, however, no need to search any longer for a natural source of vitamin D, since we are now able to produce this important vitamin artificially by irradiation of ergosterol (Biochem. Jour., 389; 1927). Irradiated ergosterol possesses extraordinarily potent anti-rachitic activity, 1/10,000-1/20,000 mgm per diem preventing and curing rickets in rats. Clinical experience has since shown that human rickets also is rapidly cured by daily doses of 2-4 mgm. The amount to be incorporated with margarine need, therefore, be only extremely small. By a study of the best conditions of its formation in yeast, a practically unlimited supply of ergosterol should be available for this purpose.

The margarine manufacturers have therefore at their disposal, if they care to make use of them, means which should make a perfect biological substitute for butter accessible, without unduly raising the price of margaine. Moreover, by carefully controlled methods of manufacture, it should be possible to supply a product of constant vitamin content, superior in this respect to natural butter, the vitamin content of which depends on too many uncontrollable factors of the food supply of the cow

O. ROSENHEIM. T. A. WEBSTER.

National Institute for Medical Research, Hampstead, N.W.3, Sept. 13.

#### The Mechanism of Formation of the Latent Photographic Image.

A KNOWLEDGE of the process whereby the latent image is produced on the exposure of a photographic emulsion to light is of primary importance to those engaged in fundamental photographic research. For some years past this problem has been under investigation in the laboratories of the British Photographic Research Association, and considerable progress has recently been made in our knowledge of the primary light action.

As a first step, our method has been to try to identify the photographic mechanism with some characteristic of the silver halides which can be studied by purely physical methods, in the absence

of such disturbing factors as gelatin, etc

It has been known for a long time that the silver halides possess both photo-electric and photo-conductivity properties By the former is meant the complete liberation of electrons from the salt under light action, and by the latter the freeing of electrons internally, resulting in a change of conductivity on illumination (sometimes called the internal photoelectric effect). It seemed possible to us that the mechanism responsible for one of these effects might be identified with that which produces the latent photographic image, and consequently we started more than two years ago a series of experiments to investigate thoroughly the two effects in relation to the silver halides, and especially to silver bromide

The results of a long series of experiments which were published (*Phil. Mag*, 3, 482; 1927) indicated that the photographic mechanism was not photoelectric in the sense of its being a complete liberation of electrons from the crystal of silver bromide. The evidence in support of this conclusion is that photographic action takes place in an emulsion made with silver bromide at wave-lengths very much longer than the longest which will produce any photo-electric

emission from that salt

A detailed investigation of the second, i.e photoconductivity effect, has now been in progress for more than a year, and the results already obtained seem to be sufficiently striking to warrant publication in

the form of a preliminary note.

A study of the literature indicated that in many ways a parallelism does exist between photoconductivity and photographic effects. For example, the spectral regions to which emulsions are sensitive photographically are the same on the long wavelength side as those to which the corresponding pure halides show photo-conductivity effects. Take the most important case—that of silver bromide. The photographic spectral sensitivity of a slow silver bromide emulsion increases very rapidly towards the blue from practically nothing at about  $\lambda5000$ . The very trustworthy experiments of Coblentz (U.S. Bureau of Standards, Scientific Paper No. 256) on the photoconductivity of silver bromide showed that this effect also commences in the same spectral region as the photographic effect and increases also towards the blue. To this extent, therefore, the two effects are parallel. Coblentz's results, however, showed a very serious departure from the photographic case in that as the wave-length decreased from \\ \delta 5000, the photo-conductivity effect (for equal energy) after rising rapidly to a maximum, fell practically to zero at about \$\dagger{2}4200. This, at first sight, seemed to indicate that the mechanisms producing the two effects are different, because it is well known that photographic action occurs at wave-lengths far shorter than  $\lambda4200$ .

In the case of such thickly coated plates as are commonly used in photography, there is an apparent

decrease of sensitivity as we pass from the violet to the ultra-violet. This effect has, however, been shown (Phil. Mag, 49, 1104; 1925) to be due, not to a real decrease in sensitivity of the grains of silver bromide, but to secondary effects involving the thickness of the sensitive film Experiments with thinly coated plates demonstrated (Trans. Faraday Soc., 19, 290; 1923; Phil. Mag., 48, 947; 1924) that the photographic sensitivity of silver bromide actually increases on passing from the violet to the ultra-violet. It was thought that the sharp decrease of photo-conductivity in the violet and the apparent absence of the effect in the ultra-violet reported by Coblentz might also have been due to a 'thickness' effect in the specimens used by him and was not an inherent characteristic of the silver bromide.

Since the light absorption by silver bromide increases extremely rapidly with decreasing wavelength from the blue to the ultra-violet, the former light penetrates much farther than the latter into the silver bromide layer. Since, further, the electrical conductivity depends on the whole thickness of the layer, it was suspected that the relative photoconductivity effects at different wave-lengths depends on this thickness, just as we have shown the photographic effect so to depend. Experiments were therefore undertaken to measure the photo-conductivity effects at the three wave-lengths \(\lambda\)4385 (blue), \(\lambda\)4060 (violet), and \(\lambda\)3650 (ultra-violet), and to see whether their relative values varied with the thickness of the silver bromide specimen

employed. Preliminary experiments have completely verified the predictions, and have shown that while with a fairly thick specimen (about 0.7 mm.) the relative order of effects is blue>violet>ultra-violet, yet as the thickness of the specimen is decreased, so the violet and ultra-violet increase relatively to the blue, the order given above becoming completely reversed with a sufficiently thin specimen. The thinnest yet measured is about 0 07 mm. thick, and even for this the effect of a given amount of energy is about twice as great at  $\lambda 3650$  as at  $\lambda 4358$ . Thus what seems to have been the greatest difficulty in the way of demonstrating the identity of the photographic mechanism and that which produces a change in electrical conductivity on illumination, has been removed.

There is considerable experimental evidence that the mechanism of the photo-conductivity effect observed with many crystalline metallic halides involves the loosening of electrons from the halide ions of the lattice. The present work therefore adds considerable weight to the hypothesis that latent mage formation involves the transfer of valency electrons from bromide ions to silver ions, resulting in the formation of metallic silver and free bromine. F. C. Toy.

Physics Department, British Photographic Research Association. (Communication No. 66)

#### The Spacing of Young Trees.

WITH reference to the article on the spacing of young trees in NATURE of July 23, practical foresters in Great Britain might be glad to know the results of any experiments in spacing carried out in high and exposed situations and loose peaty soil While the best results cannot be hoped for under these conditions, the comparative cheapness and unproductive character of land of this class render it tempting for afforestation with sitka spruce and perhaps other

It is obvious, however, that restricted root development and the production of somewhat top-heavy trees are a source of danger where woods are exposed to violent winds. May it not be preferable to space more widely in these cases and raise a crop of admittedly inferior trees, rather than follow the usual recipe and perhaps get the plantation irretrievably damaged after the first thinning? An isolated tree is often extraordinarily storm-proof as compared with trees in the interior of a well-grown wood, but of course its commercial value is small.

It would be interesting to know more of the possibilities and limitations of successful forestry on the bleak high-lying moorlands so common in many parts of Britain. Some of these moors and fells were certainly covered with large timber at one time, to judge from the evidence of place names and the actual trunks uncovered in peat cuttings, but replanting is a difficult problem now that cover is destroyed and the soil either denuded or overlaid with peat bog

EDWARD P FRANKLAND

Needlehouse, Ravenstonedale, Westmorland.

THE article in NATURE of July 23 refers to the possible effect of wide planting distances upon the quality of the tunber to be produced. I can remember the time when the chief criticism to which British forestry was exposed (by those who considered Continental practice ideal for the production of commercial timber in Great Britain) was connected with this very practice of wide planting, associated with or without early thinning. The advocation of the former at the present time would suggest that sylviculture, which at one time was considered by far and away the most important branch of forestry, is to be put into the background for financial reasons The pros and cons of wide or narrow spacing are fairly well known. In the case of species which grow quickly, or under conditions which favour quick growth during the first twenty years or so, close spacing does not always produce satisfactory results, unless early thinning is resorted to. This thinning is, however, under average conditions, unremunerative, and the argument that the expense of thinning can be avoided, and the cost of planting reduced by possibly 50 per cent. through wide spacing, is at any rate plausible enough.

The fact is often overlooked, however, that the question of importance is not altogether one of the number of trees per acre standing five years or so after planting, or which are usually regarded as established. Of far more significance is the uniform distribution of these trees over the surface, so that the competition for space and light is not eliminated in one place and excessive in another. The actual spacing may produce coarser or cleaner poles, obviate or necessitate early thinning, or reduce or increase the initial expenditure, as the case may be, but the final results are in all cases determined by complete canopy or stocking of the total planted area at an early age, and before branch development has proceeded too far for the production of reasonably clean timber.

The condition desired is not so easy to attain as many imagine. The deaths or failures which occur during the first two or three years after planting may be due to a variety of causes, but under average conditions they will occur over a larger or smaller proportion of the total area, and not with the same mathematical regularity with which planting was carried out. But these failures impose a duty on the forester which cannot be neglected if timber of the class and quality capable of commanding an open

market is to be secured. This duty is to thicken up or fill in weak and gappy spots sufficiently early to enable the crop to attain the desired density. The extent to which this may be necessary does not depend upon the original planting distances, but upon other factors which apply to both thick and thin planting alike, but it obviously affects the cost of establishing plantations, and may convert originally low into ultimately high planting costs in the course of two or three years.

If the timber of northern Europe is to be partially or entirely replaced by home production, sylviculture must be considered in the same light as high farming. Costs of production must be studied from a relative rather than an absolute point of view, and cheap planting may not lead to profitable afforestation

A. C. Forbes.

9 Upper Mount Street Dublin.

One of the points in Mr Frankland's letter is answered by Mr. Forbes in his last paragraph, in which he enunciates a correct sylvicultural prescription that sylviculture and high farming are not dissimilar, in that the former requires at least as close a knowledge and practice, and that to curtail expense in the first years is to produce an inferior article which may prove unsaleable at a profit. Mr. Frankland's second point on the subject of the possibilities and limitations of successful forestry on the high-lying moorlands so common in Britain is not at present easily answered since practical experience is almost absent. It may, however, perhaps be stated with some confidence that the solution is unlikely to be found in wide spacmg. To be successfully marketed, tunber from such regions must be of as high a quality as possible. In France, where since the War exposed areas of this type are being afforested, this business is being approached from the viewpoint that close spacing is the first necessity; and that this spacing must be maintained until close canopy has been produced. Subsequent thinnings will probably be delayed owing to the slower growth to be expected, but such thinnings will be carried out as required, irrespective of whether the material is saleable or otherwise.

THE WRITER OF THE ARTICLE.

#### Possible Mechanism of Atomic Disintegration.

The experiments of atomic disintegration (Rutherford, Chadwick, Kirsch, Pettersen, Kara-Michailova, Bieler, etc.) show that by bombardment of  $\alpha$ -particles it is possible to obtain hydrogen emission. Taking the case of heavy atoms, with big nuclear charges, it the  $\alpha$ -particle cannot reach the nucleus, then hydrogen must come from the more external part of the atom.

On the other hand, the experiments of Aston and others show the presence of hydrogen in the discharge tubes: astrophysical observations also show the extraordinary abundance of hydrogen in stellar atmospheres, where atoms are, because of the high temperature, in a state of advanced ionisation. The phenomena are ascertained and so significant that it is necessary to relate them to the atomic structure.

Rutherford and Chadwick have already supported the view that satellites may exist around the nucleus; but to give a satisfactory representation of the phenomenon, I think it may be useful to consider the difference P-2N (used already by Harkins for other purposes, with the name of 'isotope weight'), where P is the atomic weight and N is the atomic number.

I have called this difference the 'excess weight,' and I have thought of it as constituted by P-2N

doublets or dipoles, externally to the atomic nucleus, formed by one positive and one negative electron near enough to have them forming an electrically neutral complex. We may then understand how the number of these dipoles (which must be accommodated in the mtra-atomic fields) must eventually depend on the atomic structure. There are, indeed, some facts that can be related to the present hypothesis and seem to show this dependence

Let us consider the three following magnitudes as functions of the atomic number:

(a) The range of 'variability of isotopes,' namely, the difference between the weights of the higher and the lower isotope of each element,

(b) The 'maximum excess weight,' namely, the excess weight of the higher isotope of each element, or the maximum number of doublets a given atomic configuration can accommodate;

(c) The excess weight calculated from the simple atomic weight

About the range of variability we may remark .

(1) It seems that no relation exists between the range of variability and the atomic number: this fact is very well known.

(2) The range of variability is of well-defined beliaviour in the various groups of homologue elements. these behaviours are generally different when we come to consider different groups of elements.

(3) Radioactive elements have a completely different behaviour from that of non-radioactive elements

(4) Elements following the rare earths group seem to be affected by the difference of atomic structure.

These remarks seem to show that the range of variability of the isotopes depends on the particular nature of the elements, and ultimately, on their atomic structure.

Let us consider the maximum excess weight we may examine the first twenty elements of the periodic system, possessing a relatively simple atomic structure. These elements can clearly show the existence of an eventual relationship between P-2N max, and their atomic structure. Indeed, this relationship exists and P-2N max, has a perfectly distinct behaviour in each period. The greatest deviations of P-2N max happen in correspondence to neon and argon in coincidence with the closing of the 8-electron ring. The following facts stand to show that this coincidence cannot be casual

For the mactive gases and bivalent metals—zinc, cadmium, mercury—P-2N max, doubles each time a given atomic structure is repeated: as a matter of fact, for neon, ending a period of 8 elements, P-2N=2; for argon, ending a second period of 8 elements, P-2N=4, for krypton and xenon, ending respectively a first and a second period of 18 elements, P-2N=14 and P-2N=28; but for radon, ending a period of 32 elements, P-2N=50. For the bivalent metals, zinc, cadmium, and mercury, we get the values 10, 20, 44, we observe then an identical behaviour as for the inactive gases. The remaining elements follow different rules.

The mactive gases and the bivalent metals above mentioned, which follow the law of doubling, are characterised upon the curve of ionisation potentials (L. Rolla e G. Piccardi, Gazz. chim. ital., 56, 512; 1926) by maximum positions and correspond, following Bohr, to complete saturation of electronic orbits (external, in the case of the mactive gases, internal to a 2-electron ring, in the case of the bivalent metals). This also shows that the excess weight does not change casually, but in relation to atomic structure.

We note, therefore, that in passing from the elements of the second short period to the homologues of the first long period, P-2N max, increases from 8 to

12 units, and that going from the elements of the first long period to the elements of the second long period P-2N max increases from 8 to 14 units. In the case of structures growing more complicated, as for the atoms following calcium, it is more useful to consider the excess weight calculated on the basis of simple atomic weight which, among all possible weights, represents generally the most probable one, rather than the excess weight of the maximum isotope we may, in doing so, eliminate many gaps and uncertainties which still to-day limit our knowledge about isotopes

The graph of P-2N shows periodicity in the three long periods—these periodicities point out that the probable excess weight varies in a uniform way in every group of homologue elements.

In an interesting paper by Diaz De Barros (Comptes rendus, 181, 719, 1925) no explanation was offered of the remarkable periodic properties we have pointed out, and the present hypothesis could perhaps, if worked out quantitatively, prove fruitful in developing existing conceptions of nuclear constitution.

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#### Method of Manufacture of the Sligo Implements.

An examination of the whole of the material now available makes it abundantly clear as to the general plan upon which the Sligo implements were made (see NATURE, Aug. 20, p 260). The raw material used is limestone, and this rock is present upon the Sligo coast in the form of horizontal layers about 1 foot thick and 13 feet wide. These layers fre-

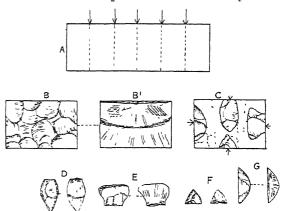


Fig. 1—Diagrams illustrating manner in which the limestone of Sligo was flaked into implements.

quently break with a fracture vertical to their longer axis, thus producing oblong masses of limestone such as is outlined in Fig. 1 (A).

It is evident that these oblong masses were broken into 'steaks' by blows delivered upon the more or less flat upper surface. The method of fracture was probably to hurl a large stone upon any of the points indicated by arrows in Fig. 1 (A), and so to induce a cleavage in a direction shown by the dotted lines. The blocks of limestone thus detached possessed four more or less flat surfaces at right angles to the area of fracture produced, and these surfaces were used as the striking platforms in the next stage of the implement-making process. This stage is shown in Fig. 1 (B), and consisted in the removal of flakes over the whole of one of the larger surfaces of the block of limestone,

by blows delivered upon the four flattish sides other face of the block, Fig. 1 (B1), exhibits the fracture surface, with bulb of percussion produced in the initial detachment of the mass from the parent rock.

Having covered one surface of the block with flake scars, blows were then delivered with a hammerstone at certain selected points along the sides of this surface, and Levallois flakes of various type detached. These are indicated in Fig. 1 (C) by continuous lines, while the arrows show the direction of the flake-removing blows. The original flaking of the surface of the block remaining unaffected by the removal of the Levallors flakes is indicated in Fig. 1 (C) by dotted The flakes so detached exhibit, on their upper surfaces, the truncated remains of the flake scars originally present upon the flaked block, while the under surface shows the bulb of percussion formed when the specimens were removed. After this detachment the Levallois flakes were trimmed to the desired shapes by blows delivered upon the under surface (Fig. 1 (D, E, F, and G)). and this completed the implement-making process.

It will be noticed that this process, as carried out by the palæolithic people of Sligo, bears a very close resemblance to that practised in Mousterian times in the manufacture of flint implements. In fact, the only way in which the Sligo method differs from the other is:

a In the breaking up of the raw material into suitable blocks; and

b. In the detachment of more than one Levallois flake from the prepared core.

These differences are, however, explained first by the differing nature of the raw material, which necessitated the adoption of a different method of preparation, and secondly, by the fact that, having produced a comparatively large area of flaked surface (Fig. 1 (B)), it would have been very wasteful to have detached merely one Levallois flake from it.

Not only is the manufacture of the Sligo implements comparable with that in vogue in Mousterian times. but the forms of the specimens themselves are also clearly the same as those of implements referable to the latter epoch. Lastly, distinct facetting of the striking platforms of some of the Sligo artefacts is observable, while the secondary work along the edges is usually composed of resolved flake scars; and, as is known, both these peculiarities are particularly marked upon implements of the Mousterian period. The Sligo limestone has a marked conchoidal fracture, accompanied by the production of radiating fissures, and this enables the direction in which any particular flake was removed to be ascertained with considerable accuracy.

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### Coming British Eclipses.

Dr. HIND published some calculations about the eclipse of June 30, 1954, more than half a century ago. He first announced that it would be total in the northern part of the Shetland group, but afterwards cancelled this, stating that the track would lie a few miles north of the group. I made independent calculations of the eclipse some twenty years ago, but a

numerical error in the final steps escaped notice; this error caused the track to miss the Shetlands, thus confirming Hind I have recently repeated the whole calculation quite independently, using Hansen's tables with Newcomb's corrections for the moon, and Newcomb's for the sun, estimated corrections were applied as follows . +8'' 5, -0'' 8 to the moon's longitude and latitude, +2" 3 to the sun's longitude. The error in my former work was brought to light, the two calculations agreeing perfectly in every other respect. The surprising result emerges that Hind's first announcement was correct; the eclipse is total throughout the island of Unst, and in the northern part of Yell and The point taken for calculation, on the north Fetlar. coast of Unst, is 0° 45′ 7 W, 60° 49′·4 N Totality here lasts 117 seconds, the duration on central line being The sun's altitude is 52° 12' 156 seconds

The conditions are thus extremely favourable, and

it is rather strange that Hind's error has not been detected sooner. The eclipse is also observable in İceland, Faroe Islands, south Norway (Bergen), south Sweden (Oland I.), Memel, Tilsit, Sea of Azov. It is a repetition after three Saroses of the 1900 eclipse (Spain and Algiers); the series gives another European eclipse (Finland and Lapland) in 1990, besides the Constantinople eclipse of 1936.

Some doubts having been ex-

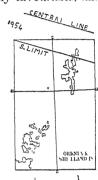




Fig. 1.—Tracks of total solar eclipses of 1954 and 1999.

pressed (notably by Herr C. Schoch, who is an authority on ancient eclipses) as to whether the 1999 eclipse would be total in England, I have recently investigated it, using Brown's Tables for the moon, with corrections of + 18", + 1" 7 in longitude and latitude, and Newcomb's Tables for the sun, with correction +3" in longitude. The result vindicates the almost perfect accuracy of Hind's track published in Nature of Dec. 30, 1875; my track is 5½' south of his, and passes 11½' north of the Lizard. The Rev. J. Maurus Moorat, O.S.B., has kindly made an independent calculation for check, using Hansen's tables of the moon; his track does not differ greatly from mine, but lies a few iniles farther north, thus placing beyond doubt the fact that totality reaches England. In fact, three quarters of Cornwall, the southern quarter of Devon, and a small portion of Dorset about Portland Bill will enjoy totality, as will also a large tract in north-east France. The duration of totality is 2 minutes; the sun's

Comparison may be made of the above results with those of Mahler, which are based on Oppolzer's Canon of Eclipses. Mahler indicates totality in Unst in 1954, his central line being 11 miles north of mine; m 1999 Mahler's central line is about 14 miles south of mine, running through the Lizard. It will be remembered that all Mahler's tracks are decidedly too wide, since he uses Hansen's value of the moon's semidiameter, which is 21" too great for eclipse

<sup>1</sup> A revision of his work makes it practically coincident with mine.

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purposes. Since the lunar tables used by Oppolzer omit many small terms, Mahler's tracks are uncertain by fully 25 miles, so the discordances found are not

unduly large.

The central lines and limits of totality in these two eclipses are indicated on the accompanying map (Fig. 1). The occurrence of these two favourable British totalities within 45 years of each other is some compensation for the unusually long barren period which has just ended

A. C. D CROMMELIN.

#### The Production of Sound by Heat.

Prof Knipp, in his letter to Nature of Sept 10, seeks for reasons why the 'singing tube' was not discovered long ago by research workers doing their own glass-blowing. In point of fact, it was so discovered. I observed it when making for my father, some vice with the foregroups the context. father some vacuum tubes for examining the spectrum of argon, about 1896. But I found that it had been long familiar to him. He discussed it in a lecture at the Royal Institution (*Proc. R I.*, **8**, p. 536; 1878 NATURE, **18**, p. 319; 1878. Collected "Scientific Papers," vol. 1, p. 350) giving a mechanical explanation similar to that of Prof. Knipp. He had learned the facts from a paper by Sondhauss, which might no doubt be easily located from the Royal Society's catalogue of scientific papers I am, for the moment, away from easy access to a scientific library

RAYLEIGH.

Beaufront Castle, Hexham, Sept. 12.

In an interesting letter on a 'singing tube' which emits a sound when heated at the sealed end near a constriction, Prof. C. T. Knipp gives reasons "why it was not discovered long before by research workers doing their own glass-blowing." However, Sondhauss had a paper in the Annalen der Physik on the subject in 1850 (Vol. 79, page 1). He says at the commencement (I translate): "Many physicists must have observed that bulbs blown on glass tubes of 2 mm to 3 mm. diameter often give out a tone, so long as they are strongly heated; observations on these have been made public only by Pinaud (Pogg. Ann, 42, 610; 1837) and C Marx (Erdmanns Journal fur praktische Chimie, 22, 129; 1841). I had observed the same before Pinaud's publication . . . and was led to take up a more particular study of the phenomenon." Sondhauss rightly considered the source of sound to be the vibrations of the air in the 'singing tube' and gave an empirical formula for the frequency of the tone emitted by a tube having a spherical bulb blown on one end.

I should like to add, from my own observation, that a plain cylindrical tube can be made to 'sing', by means of a hot gauze, even if the latter is placed at a loop, i.e. at the open end of the tube, provided a supply of coal-gas be admitted to the tube and lit just above the gauze. This is known as 'Lissajous' whistling flame,' although I have never been able to trace the reference. By using a lighted Méker burner for the gauze with gas lit above, I was able to produce ear-splitting howls when the burner was placed just beneath the open end of a long brass tube.

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Climatic Changes: Their Causes and Influences.

The evidence for climatic changes in Great Britain about the thuteenth century is not so inconsistent. as Prof Gregory makes out in his reply to Mr Meyer in Nature of Sept. 10. Literary records tend to be comparative (as I have previously explained), so that one would expect most records of droughts to occur at a time when the climate was becoming drier rather than during a time of stable dry climate. Thus, both literary records and the cast Kent watermills discussed by Mr. Meyer point to a rapidly decreasing rainfall in England in the latter part of the thirteenth century. There is probably plenty more evidence of a similar nature buried in old documents, county histories, etc., and only waiting for the spade of the antiquarian.

I cannot claim any direct acquaintance with the sagas, but O. Pettersson appears to have studied them in sufficient detail, and his arguments about the comparative freedom of the Greenland waters from ice in the tenth century have been thoroughly confirmed by the recent excavations at the Eastern Settlement. Absolute freedom from ice is only suggested as a possibility, and not argued as a probability, but I should not care to deny it from arguments about the climate of Britain at that time, for two reasons; first, we do not yet know how or to what extent changes in the ice area off Greenland affect British weather, and secondly, we know practically nothing of the climate of Britain

in the tenth century.

C. E. P. Brooks.

34 Glenhurst Avenue, N.W.5, Sept. 10.

#### Black Sea Earthquakes of Sept. 11 and 12, 1927.

Good records of the above series of earthquake shocks which were felt on the northern coasts of the Black Sea were obtained with the Galitzin seismographs at Kew Observatory In the following table are summarised the times of arrival of the primary phase (P), and secondary phase (S), together with estimates of the times of origin (O), distance of epicentre  $(\Delta)$  and co-ordinates of the epicentre. The centre (A) and co-ordinates of the epicentre co-ordinates have been worked out using Strasbourg and Kew observations, and the figures given are provisional only All times are Greenwich Mean Time.

	Day	Hour	P		S		0		۵	Epicentre
'	Day		m	s	m	s.	m.	s	km	Elucentie
I III IV V V	Sept 11 11 12 12 12 12	22 23 3 6 14 19	21 49 25 38 29 36	2 50 22 43 12 (22)	25 54 29 43 33 40	18 18 46 6 28 (42)	15 44 19 33 23 30	41 13 50 12 51 (55)	2640 2800 2750 2730 2640 (2690)	45° N , 34° E . 15° 5 N , 37° E 45° 5 N , 36° 5 E 48° 5 N , 35° E 45° N , 34° E .

In the case of the first shock, it was possible to make an estimation of the azimuth of the epicentre from the Kew records alone. Using this estimation, the epicentre was found to be 43° N., 34° E. The shocks numbered I. and V. give the largest records, and it is probable that the co-ordinates given of these two quakes are the most correct for the series of shocks.  ${
m \hat{A}n}$  earthquake occurred in the same region on June 26of this year, and the epicentre worked out at Strasbourg was given as 45° N., 34° E.

R. E. WATSON.

Kew Observatory, Old Deer Park, Richmond, Surrey, Sept. 19.

# Telekinesis and Materialisation.

By Dr. E. E. FOURNIER D'ALBE

THERE are certain classes of phenomena, both physical and biological, which for two generations have been persistently pressing for recognition by official science, and have been as persistently refused such recognition With the present worldwide organisation of scientific research, such a situation is, to say the least, unusual. It is not as if new observations were habitually neglected. Quite the contrary The announcement of a new discovery instantly sends a flutter through the universities and research laboratories, and within a week hundreds of competent men are eagerly testing, repeating, and criticising the alleged After a short period of doubt and discovery perhaps controversy, the innovation is either confirmed or discredited, and the attitude of science towards it is settled.

This sifting process is particularly rapid in physical and chemical phenomena, where spurious discoveries are given short shrift. We need only recall the recent 'death-ray' scare to realise the

rapidity and finality of the process.

When a biological or psychological factor is involved the decision is often delayed. It took nearly three years to demolish Blondlot's 'N-rays, and even then the Académie des Sciences awarded him a prize of 20,000 francs for his (more or less futile) researches in a field of unusual difficulty.

In medicine the issue may be in doubt even longer, as in the case of Koch's tuberculin, though the rapid recognition of insulin as a cure for

diabetes is an example to the contrary.

It would be difficult to find cases where facts and their interpretations have been in doubt for more than fifty years. Yet that has happened in the case of the alleged phenomena of 'tclckinesis' and 'materialisation.' They belong to the class of phenomena formerly termed 'occult,' but as this term is too suggestive of the Middle Ages, more up-to-date names such as 'supra-normal,' 'hyper-physical,' or 'metapsychic' have been invented. Currently they are called 'mediumistic,' on account of their association with spiritualism

The word 'telekinesis' was coined by Alexander Aksakow, the first man to attempt to erect occultism into a science. It denotes the movement of objects at a distance without normal means. 'Materialisation' means the formation of organic or inorganic structures from material borrowed from the body of the person in whose presence the phenomena take place, and who is essential to This person is barbarously their production. called the 'medium,' though the word 'psychic'

is often preferred

'Materialisation' was first heard of in 1870, when Mrs. Andrews, of Moravia, N.Y., produced spirit forms.' These were originally supposed to be efforts of disembodied spirits to take on ordinary substance for the purpose of making themselves visible to mortals. No importance was attached to these and similar phenomena by scientific men until 1871, when Prof (later Sir William) Crookes announced his intention to make a series of test The experiments were spread over experiments three years, and led to the most amazing results. which, if corroborated, would have revolutionised

both physics and biology

Unfortunately, they were conducted without those extensive precautions without which, as experience has shown, it is impossible to arrive at a clear-cut decision in these matters himself seems to have felt that he was losing his He abruptly stopped his investigations, and for the rest of his life confined himself to an unprogressive attitude of general assent to the spiritualist position. But his action gave a tremendous impetus to occultism generally, and a succession of famous mediums did their best to reach the pinnacle of D. D. Home and Florence Cook Eusapia Paladino in Italy, Marthe Béraud Eva C.') in France, Kathleen Goligher in Belfast, Willy Schneider in Austria, and 'Margery' (Mrs. Crandon) in America, are the only ones who have been subjected to scientific tests.

Of these, Eusapia stands out as the most remarkable personality. She was born at Minervino-Murge in the Abruzzi in 1854. Orphaned at an early age, she went into service at Naples, and soon got caught in the epidemic of table-turning which prevailed in the 'seventies. At twenty-two she was discovered 'by the Florentine spiritualist Damiani, who had been strongly influenced by the work of Crookes. We accordingly find that Eusapia's chief 'control' thereafter was a spirit called 'John King,' who claimed to be a brother of 'Katie King,' the amiable spirit maiden whom Crookes had embraced at one of his most remarkable séances. At thirty-two she had married a small shopkeeper, but soon she was lifted out of her lowly sphere by the generosity of Cavahere Chiaia, who educated her and afterwards introduced her by open letter

to Lombroso, the famous criminologist.
"Bound upon a chair," he said, "or held tightly by the hands of the curious, she attracts the furniture round her, raises it up, keeps it suspended m mid-air like Mahomet's coffin, and makes it descend in a wavy motion, as if obedient to a strange will. She increases or diminishes her weight av will. She raps and hammers on the walls, the ceiling, or the floor as requested. . . . When her arms are fastened, a third arm appears, nobody knows whence, and plays amusing pranks. It removes hats, watches, and money, rings and pins, and skilfully returns them . . . A large, horny hand, which makes you feel cold down your back, may be grasped, pressed, and mspected, and finally rises and hangs in the air, as if severed at the wrist, resembling the wooden hands hung outside their shops as signs by glove-

This introduction led to the complete conversion of Lombroso, who was eventually persuaded that he had embraced the spirit of his dead mother, materialised through Eusapia's mediumship

Eusapia soon became famous She travelled all over Europe. But she was not always equally fortunate. The Society for Psychical Research found she had a trick of freeing one hand by joining the hands of the persons controlling her But such exposures do little harm to established mediums.

Practically all the well-known mediums have been detected in fraud at one time or other for every such exposure there is a ready excuse The medium is in a state of trance or semi-consciousness, and the controlling spirits are of all kinds, even tricksters When Florence Cook was, in 1880, caught impersonating the spirit 'Mary' in other words, when she was convicted of fraud, the explanation advanced was that it was a 'transfiguration' The supernatural element is introduced at every stage Even when not deliberately mentioned, it is made to influence the investigator in the form of a demand for 'sympathetic' In a word, the application of the scientific method is rendered impossible by making the success dependent upon the whim of a supernatural entity.

During the study of mediumistic phenomena for more than twenty years, I have met most of the famous mediums and have had occasion to defend some of them against what I believed to be hasty and ill-considered judgments. I had great hopes of Eva C and Miss Goligher, thinking they would furnish the groundwork of a new science. But at every step the investigator is baffled by the 'unseen operators'—be they embodied or disembodied—who will not come to a clear-cut issue.

The reviewer in Nature of Geley's "Clairvoyance and Materialisation" says, in the issue of Aug. 27, p. 296: "It seems to me the duty of science either to show that, in the nature of things, there is no inherent possibility for the existence of ectoplasmic matter, or to attempt a tentative explanation of the phenomena" I regard the former alternative as impracticable. Who can set a limit to the possibilities of the organic world? Every individual born is a new experiment, and none can say what strange beings may yet be produced, or with what wonderful faculties they may be endowed.

If we must have a tentative explanation, there is one ready to hand. The alleged phenomena of telekinesis and ectoplasm are all spurious, and are due to faulty observations or faulty conditions How difficult the conditions of the average séance are can only be realised by practical experience illumination is of the order of 0 001 foot-candle, and is usually considerably over-stated. observer is wearied by hours of strained attention without anything happening Often the sitting is entirely barren, and before the next sitting he will naturally examine his conscience to see whether an undue insistence on evidential conditions may have inhibited the phenomena. So he relaxes them. Then he gets phenomena. But they are no longer evidential

Out of the large array of mediums who have

shown the phenomena of 'teleplasm' or 'ectoplasm.' only three have been investigated under scientific conditions. Dr Baron von Schrenck-Notzing spent several years in studying Eva C. He gives the following description of ectoplasm

"The Ectoplasm on further condensation becomes white and transforms itself into amorphous coagulated masses or packets, or assumes the structure of the finest web-like filmy veils. Sometimes the veil-like forms are doubled over at the margin, so that the first impression is that of a stitched hem. The veils never show the Characteristic square thread-work of real veils.

"The pieces look like torn shreds of fabrics, or like ribbons, strings, or long fibres, or again like low organisms. . . . The mass seems to pass freely through the lighter materials of the dress, penetrating them, perhaps in a vaporous form, and subsequently condensing in the form of grey flakes

"The experiences with Eva C show many correspondences with the phenomena of Eusapia Paladino. The symptoms of mediumistic labour and its muscular accompaniments were found in both persons. The same utterances of pain, the same moaning and pressing, the same effort of will."

On two occasions Dr von Schrenck-Notzing was able to obtain samples of the substance, and subject it to analysis. The first sample was indistinguishable from human skin such as might be peeled off a human heel. The second sample closely resembled saliva in its microscopical character.

In March 1922, Eva C. was investigated by a committee appointed by the Psychological Institute of the Sorbonne This committee reported that what phenomena there were could be produced by regurgitation. The same result had been arrived at by the London Society for Psychical Research in 1920.

The case of Kathleen Goligher resembled that of Eva C in many particulars, but her phenomena were unaccompanied by the signs of physical distress exhibited by the other mediums. Dr. Crawford published numerous photographs, which strongly suggest the textile nature of the substance This was established by me in 1921, when I succeeded in taking the only contact photographs of ectoplasm ever obtained. They were taken by putting the photographic plates on the floor under the table and requesting the 'operators' to place some ectoplasm upon them. When all was ready, a small electric lamp fixed on the under side of the table was switched on for a few seconds. The results showed the unmistakable structure of chiffon or a similar material.

Quite recently another case of materialisation, in connexion with 'Margery' (Mrs Crandon), was investigated by Mr E J Dingwall He found the materialisations resembling animal tissue 'The appearance," he says, "suggests something analogous to lung tissue, and the smell of the substance which, according to Dr. Worcester, resembled the

smell of the entrails of a freshly killed animal, pointed in the same direction."

There is nothing in all this to make out a plausible case for the assumption of a new substance called 'teleplasm' or 'ectoplasm' It is impossible to extract from the literature on the subject any consistent description of its supposed properties In the days of Katie King, the apparition was able to cut off portions of her dress and distribute them to her audience, who found that they resembled ordinary calico. Nowadays the substance is supposed to be very fugitive and sensitive to light. The hypothesis which seems to cover all the facts is that a succession of mediums, under pressure from sitters anxious to see marvels, have produced these 'spirit forms' by trickery. This trickery has become increasingly difficult and has practically disappeared whenever test conditions are applied. It is, therefore, impossible to admit the existence of any new facts, and even a tentative explanation of them is uncalled-for. Science might just as well concern itself with the anatomy and physiology of fairies.

There is another matter which must not be overlooked. The forces behind occultism and supernaturalism are very powerful. They are based upon the very human craving for the mar-

vellous All religions contain this element, and promote it in various ways. There is a tendency in modern times, especially in America, to link religion with science, so as to utilise the growing prestige of the latter. The funds available for the enterprise of winning the approval of science for the modern miracle are very considerable. A wealthy French spiritualist recently established and endowed an International Metapsychic Institute in Paris, and appointed as its director a local practitioner of spiritualistic sympathies, Dr. Gustave Geley. The publication of his conclusions and speculations in an imposing and expensive volume formed a very telling piece of propaganda.

Such institutions form a kind of spearhead forged by occultism for piercing the armour of science, and it would not be surprising to see the foundation in England of an Imperial Academy of Natural and Supernatural Science, generously endowed from British and American sources—Its prospectus would be liberally sprinkled with the names of Crookes, Lombroso, Richet, Flammarion, Geley, Crawford, and von Schrenck-Notzing, and everybody would know that science had at last become 'spiritualised' and centred in other worlds than ours; and sacerdotalism, having been expelled by the door, would come back through the window.

# Base Exchange and the Formation of Coal.

By Dr. E. McKenzie Taylor.

DURING a soil survey of the northern portion of the Nile Delta for reclamation purposes, a deposit of vegetable debris was discovered at a depth of two metres below the soil surface. As this deposit was found to contain peat, fusain, and partially fusainised material, an association that does not appear to have been recorded previously, it appeared that an investigation of the conditions under which the deposit existed might afford evidence of the mode of formation of coal. It is accepted that coal has been formed from vegetable material, and it has been generally assumed that the vegetable material accumulated as peat. The connexion between peat and coal has, however, not been established.

An examination of the soil overlying the vegetable layer in Egypt showed that it was alkaline and that the principle replaceable base present was sodium. The soil had originally been formed by the deposition of Nile silt in which the main replaceable base is calcium. The conditions under which the soil was situated showed that the conversion of the calcium-clay in the Nile silt into sodium-clay had taken place as the result of base exchange with sodium chloride solutions, and that the alkalinity had been produced by the subsequent hydrolysis of the sodium-clay in fresh Investigations in the laboratory have shown that it is possible to maintain the alkalinity of a medium for a considerable length of time by the hydrolysis of sodium-clay. It has also been shown that a roof containing hydrolysing sodiumclay is impermeable to gases and water, that the conditions under such a roof are anaerobic, and that

the alkaline medium produced under such a roof is suitable for the continuous bacterial decomposition of organic matter.

A study has been made of the bacterial decomposition of organic materials under the alkaline anaerobic conditions furnished by a roof containing sodium-clay. Sugars, starch, and cellulose decomposed under these conditions yield gaseous products only, the gas produced accumulating beneath the roof. An examination of this gas showed that it was principally methane, the carbon dioxide produced during the decomposition having been absorbed by the sodium hydrate resulting from the hydrolysis of the sodium-clay. Mature leaves were submitted to bacterial decomposition under a sodium-clay roof. The residual solid product was black and possessed the typical fusain structure. Analyses of the leaves at intervals showed that elimination of oxygen was taking place and that the process of decomposition was continuous. The bacterial decomposition of peat under a roof containing sodium-clay was also investigated. It was found that peat could be decomposed under the alkaline anaerobic conditions, that the alkali-soluble 'humus' in the peat was removed in solution from the seat of the bacterial action, and that the gas accumulating under the alkaline roof was methane The investigation of the bacterial decomposition of organic materials under a roof containing sodium-clay has shown that bacterial activity in the continuously alkaline medium is not inhibited by the accumulation of toxic products of the decomposition and that the solid residue is a reduction product. It has also

shown that peat can be decomposed under alkaline anaerobic conditions

As peat can be decomposed by bacteria under an alkaline roof, and as vegetable material decomposed in such a situation yields a solid reduction residue with a fusain structure, the occurrence of a peat deposit containing fusain under an alkaline soil points to the conclusion that fusain is a decomposition product of peat under the alkaline anaerobic conditions imposed by a roof containing

hydrolysing sodium-clay

Since fusain is a constituent of bituminous coal, it seemed probable that bituminous coal might have resulted from the bacterial decomposition of vegetable material under alkaline roof conditions A considerable number of specimens of the roofs of coal seams in Great Britain were examined, and it was found that the great majority were alkaline and that sodium was the main replaceable base The exceptions to these rules were of two main types (a) coarse-textured shales or black sandstones, and (b) white sandstones and con-The final result of the hydrolysis of glomerates sodium-clay is the production of an unsaturated clay with an acid reaction. If the amount of reactive clay present in the roof was originally small, complete hydrolysis is likely to have taken place under fresh-water conditions with the formation of an unsaturated residue with an acid The coarse-textured shales and black sandstones would contain comparatively little reactive clay material, and hence the sodium compound would be liable to complete hydrolysis The first exception is apparently due to the complete hydrolysis of the sodium-clay originally present. The second type of exception is of local occurrence only and is usually in the nature of a wash-out, indicating that the sandstone or conglomerate is not the original roof of the seam. Frequently the sandstone is underlain by a thin shale layer. From a consideration of the results, it appears that the original roofs of bituminous coal seams have undergone base exchange with sodium chloride solutions, and that afterwards the sodiumclay has undergone hydrolysis in fresh water.

An examination of the roofs of the anthracite coal seams of South Wales has shown that they are also alkaline and contain sodium-clay, indicating that the anthracite in the South Wales coalfield has been formed under similar final conditions

to bituminous coal.

The results of these investigations point to the conclusion that bituminous coal has been formed as the result of the bacterial decomposition of vegetable residues under the alkaline anaerobic conditions imposed by a roof which has undergone base exchange with sodium chloride solution and subsequent hydrolysis of the sodium-clay in fresh water.

An examination of the roofs of a number of lignite seams has also been made. It appears that the main replaceable base present in the roofs of lignite seams is calcium, indicating that the roofs of these seams have not undergone base exchange with solutions of sodium chloride. Lignite is therefore not necessarily an intermediate product

between vegetable matter and bituminous coal, but is rather a decomposition product of vegetable matter under a roof containing calcium-clay.

As bitummous coals and anthracite occur in different parts of the same seam and under the same roof conditions, it is suggested that the difference in the final decomposition productsbituminous coal and anthracite—is due to differences in the material submitted to bacterial decomposition under the final alkaline anaerobic conditions It is not necessary to assume differences in the original plant materials to account for this. Differences in the decomposition products during the 'peat stage' may have arisen due to variations in the conditions of the first decomposition. This would result in a variety of products being submitted to the final decomposition under alkaline anaerobic conditions giving rise to the variety of final products composing the bituminous coal-anthracite series

Base exchange between sedimentary deposits and solutions of sodium chloride can take place under three conditions in Nature: (a) by deposition of the silt in sea water, (b) by submergence in sea water of a deposit already formed, and (c) by the reaction of the clay with capillary solutions of sodium chloride raised from a water-table containing that salt Geological evidence of base exchange under conditions (a) and (b) will be positive. Under condition (c) there will be no geological evidence of base exchange, determinations of the pH value and the nature of the replaceable bases being the only evidence on which to base a conclusion. From the examination of the roofs of the coal seams in Great Britain, it appears that the majority of the roofs have undergone base exchange with capillary solutions of sodium chloride.

The presence of the alkaline roof satisfactorily accounts for the observation that coal seam gases mainly consist of methane. Oxygen elimination from the vegetable material must have taken place during coal formation, but no appreciable quantity of carbon dioxide has been recorded in coal seam gases. The carbon dioxide produced by the oxygen elimination would be absorbed in the sodium hydrate solution resulting from the hydrolysis of the sodium-clay leaving a methane residue.

Three main conclusions concerning the formation of coal may be drawn as a result of this investigation:

(1) The vegetable material accumulated as peat. (2) The roofs of bituminous and anthracite coal seams have undergone base exchange with sodium chloride solutions, the sodium-clay being afterwards hydrolysed in fresh water. This would provide an alkaline medium under anaerobic conditions for the bacterial decomposition of peat.

(3) The decomposition of peat under a roof containing calcium-clay results in lignite formation.

The roofs of bituminous coal seams other than those of the Carboniferous System are being investigated. The results so far obtained indicate that base exchange between the roof and sodium chloride solutions is common to all bituminous coal seams and forms the connecting link between the coal seams of the various geological formations

# The Ancient History of Sponges and Animals.1

By Dr. G. P BIDDER

T is not fitting for one who is not a geologist to do more than touch very lightly on the prob-But connected with lems of the pre-Cambrian them is an interesting consideration to which I would direct the attention of fellow biologists. If we follow the American geologists in attributing organic origin to the graphites of the Grenville series at the base of the Laurentian—which are stated by Dawson to contain as much carbon as the whole American coal-measures, and with which we may class the graphite schists described by Geikie under the Scottish Lewisian, and the seven feet of socalled 'anthracite' found in Finland by Sederholm in the Jatulian, at least two miles under the Cambrian—I do not see how we can avoid the conclusion that there was vegetation growing in or about quiet landlocked waters, for many thousands of years, as long before the Cambrian as the Cambrian was before us. Among palæontologists the view prevails that it is in such still landlocked waters that rapid evolution has always taken place. It seems impossible not to believe that a terrestrial flora, and a terrestrial fauna, must have been evolved in those favourable times and the long ages which followed, to be swept to destruction in the deluge that denuded the Torridonian. If so, we see in the succession of Cambrian and Ordovician fossils—the 'marine period' of the Palæozoic, as Marr designates it—the development for a second time of a littoral from a deep-sea fauna, which fits closely with Walcott's conclusions on the Cambrian, and in the Silurian and Devonian we see the evolution of a terrestrial flora and fauna for the second time.

If all the pre-Cambrian lands were swept by fierce and terrible torrents, marine organisms might nevertheless survive in the deep abysses of the sea, to recolomse later the still-vexed Cambrian shores. It is also conceivable that exceptional organisms might survive in the tranquil abysses of the high air, or on the occasional mountain-tops; and the fancy has struck me that such isolated survivors from the ancient sub-aerial population may conceivably be recognised in the progenitor of the Ordovician winged insects, and also in the ancestor to Hugh Miller's conifer of the Old Red Sandstone.

Leaving the geologists and botanists to settle for us the truth or error of the premisses, the argument does not seem without philosophic interest:—that if the 7-foot graphite bed in Finland be of organic origin, there may be a class or classes of terrestrial animals or plants which have breathed air two or three times as long as those which left the sea in the Devonian.

The Laurentian coal, if coal it be, must mark the climax of a long evolution in the seas of the still earlier pre-Laurentian, and in that part of our history must come the primary advance which Church has rightly taught us to regard as the

 $^1$  From the presidential address to Section D (Zoology) of the British Association, delivered at Leeds on Sept 1.

greatest step in evolution, the evolution of the flagellates Church claims that, since protoplasm appeared, we may fairly estimate half the time elapsed as being required for the evolution of the flagellate. If Dr. Church measures his time in years, the geological record seems difficult to fit, for the chetopods, molluses, crustaceans, and echinoderms of the Cambrian are clearly very old But the single step in evolution is not a year but a generation, and there may well have been as many generations of our ancestors before they became flagellates as there have been since we have been multicellular. If we have been 'higher animals,' averaging ten generations a year, for 1000 million years, then some 10,000 million generations may have brought us from jelly-But 1000 generations a year would fish to men be a very moderate number for flagellates and preflagellates, so that 10 or 20 million years would give them as many steps in evolution, to make a flagellate from nothing, as it has taken us to build up a flagellate into man.

We are still lacking a satisfactory account of the early ocean in which those fateful 20 million or 200 million years were passed, and in which life began. I suggest as a working hypothesis for biologists that, since the pre-Cambrian, there have been no variations in the mean salinity of the ocean so great as the difference between the salinity in the Mediterranean and in the North Sea ocean was more or less saline: it was also soaked with carbon dioxide. In the air there was no oxygen, but nitrogen, much water-vapour, and carbon dioxide in large quantities. Life is the history of high earbon compounds, in which every atom of carbon has been in a molecule of carbonicacid gas. Volcanoes and springs have always been pouring into the air carbon dioxide from the bowels of the earth, coal-plants and calcareous animals have buried in solid form the carbon from many thousand times the quantity of carbon dioxide which we have now in the atmosphere; it is therefore probable that the alkalinity of the sea, and the dissolved calcium, have varied considerably from epoch to epoch. If all the surface of the globe were one continuous meadow, evenly producing a ton of hay an acre annually, I make out that in twenty-five years it would have fixed as much carbon dioxide as there is in the atmosphere, and in 15,000 years it would produce as much free oxygen as we have in the world to-day

We see, therefore, that the advent of photosynthetic protein in the ocean must itself have changed the physiology of the world very considerably, and that the change in conditions, after a million years' duration of the lowest form of life, rendered the world capable of supporting organisms which would have been impossible at the beginning of that age, and conceivably rendered it incapable of supporting ever again the first forms of life

Of the possible genesis of the first form of life we

heard from Dr Allen at Hull. To-day let us take up the tale, in the warm pre-Laurentian sea, with little fragments of protein lying in the sunlit waters Each fragment is continuously receiving energy—whether from the sun, according to Prof Baly's theory of activation, or from some other electromagnetic source—and with that energy is building up the molecules of the surrounding solution into molecules of protein, so that the fragment grows.

The supply of energy is continuous, and the supply of solution is continuous, yet growth of the fragment of protein cannot be continuous, because number is discontinuous. A growing fragment contains 100 molecules of protein, presently it will contain 101, then 102. It may be a thousandth of a second, it may be an hour between the moment of attaining 100 and the moment of attaining 101 molecules, but with a constant supply of energy it will be closely the same interval after acquiring the 101st molecule and before the 102nd is added Let us suppose that the interval had been 10 seconds. What will be happening during the next 10 seconds before the molecules number 103?

The continuous supply of energy must in some form be stored in the 102 molecules until its total is adequate to compel the combination of the water, carbon, nitrogen, sulphur, and the rest of it into the new 103rd molecule of protein. This stored energy is then spent in forming the combination, and for another 10 seconds the 103 molecules accumulate gradually a sufficient supply to force the combination of a 104th molecule We cannot suppose that the molecules can store energy except by a change of atomic or electronic arrangement, or that such change fails to affect their molecular volume. Expansion of molecular volume means storage of energy which is released on contraction; we may feel sure that even if the main storage of energy be in some other form, it will at least be accompanied by expansion in volume and surface. When energy is given up to form the new molecule, all the old ones will return to their original volume, and if their expansion was by more than onehundredth of their volume, the whole fragment will

A slow expansion while energy is being accumulated, a rapid but smaller contraction when the new molecule is formed, so these fragments of protein pulsate steadily through the day. So they continue through the ages, while protein enters into new combinations, and the aggregate of protein molecules is replaced by a unit of protoplasm, still keeping the rhythm of saving up energy and making-a-molecule, saving up energy and making-a-molecule.

Now protoplasm in most organisms which we can study becomes altered at the surface which is in contact with water, by a change which is conveniently called 'gelation,' the protoplasm at the surface losing most of its fluidity and changing in other properties. In certain circumstances, such as increased salinity of the water, the internal fluid protoplasm will burst out through this gelated surface in fine threads, which either gelate in their turn or change into strings of drops.

I venture to suggest that the great evolution of the flagellate, which Church pointed out to us, accomplished in some ten thousand or hundred thousand million generations, was the formation of a permanent filament of protoplasm of which one side was more gelated than the other side, so that one longitudinal strip of the cylindrical outer surface is more elastic and therefore less easily extensible than the opposite strip Let us suppose the gradual accumulation of energy causing, as before, a gradual increase in volume of the protoplasm, then the more easily extensible surface will swell, and therefore lengthen, and the filament will gradually bend When the quantum of energy is reached which suffices for formation of a new molecule, every old molecule will suddenly lose its surplus energy and return to its old molecular volume, the distended surface will return to its old dimensions and the filament will straighten.

I have spent an appreciable part of my life watching the flagella on the living collar-cells of Calcareous sponges-Grantia, Sycon, Leucandra, and Clathrina Their movement is nearly confined to one plane and is asymmetrical, being almost always with a faster beat to one side than to the other. There is a pause, a stroke, and a counterstroke Mr James Grav pointed out to me that if the counterstroke be elastic, as I supposed, it should always take the same time, as compared with the varying time of the active contraction This I found to be the case. At about 2½ double vibrations to the second, the stroke and counterstroke are of equal duration, at higher frequencies the stroke is the shorter, as in a schoolmaster's cane; at lower frequencies the stroke is the longer, as in a fisherman's trout rod. The broad features of the phenomena are therefore consistent with the hypothesis that the counterstroke is an elastic rebound.

The apparent improbability of a lowly-organised cylindrical cell, with an axial straight flagellum, having one longitudinal strip of the surface of that flagellum different from all the rest of that surface, disappears when we recognise that one longitudinal strip has a different history from all the rest of the surface. A collar-cell in a sponge is usually surrounded on all sides by six other collar-cells, of which one is its twin sister. Like all flagellates, ıncluding metazoan spermatozoa, collar-cells dıvıde longitudinally. The details of this division were worked out very beautifully by Miss Robertson and the late Prof. Minchin; and they showed that the little bead at the base of the flagellum, known as the blepharoplast, is the first thing in the cell to divide, and forms two daughter blepharoplasts which take the part of centrosomes and induce the division of the nucleus into two daughter-nuclei, followed by the division of the cell into two daughter-cells. In each of these daughter-cells the new blepharoplast grows a new flagellum will be seen that the part of the blepharoplast which was last in contact with its sister is, as it were, a healed wound, and the strip of flagellum which grows from this has therefore a different parentage from that which grows from the opposite surface of the blepharoplast, which is an intact part of

the parent surface.

There is no nervous system in sponges, and no sign of nervous control of the flagella, either from the individual cell or from the community direction and timing of their beat is wholly uncorrelated, and though the frequency of two neighbouring cells generally approximates to equality, it is not exactly the same. The frequency varies when the temperature and soluble contents of the water vary Except in certain cases where a wandering ovum (Grantia) or porecell (Clathrina) is laid over a collar-cell. I have never seen a flagellum motionless in a cell which was not moribund. I believe the motion to be ceaseless, unconscious, and uncontrolled, a direct function of the chemical and physical environment

What has this to do with the history of animals? Our ancestors were flagellates, or lower than flagellates, for as many generations as they have been anything else, for perhaps five or fifty times as many generations as they have been vertebrates, at least two hundred times as many generations as they have been mammals, and our ancestors were flagellates for at least five thousand times as many generations as they have been men. All those flagellate ancestors of ours passed their whole active lives in this continual rhythm of accumulating

energy and building, accumulating energy and building, twenty or more to the second through the whole of their short lives Is it likely that we have forgotten that rhythm? I believe that all through our growth, from infancy to prime, we added our molecules to every unit of protoplasm, rhythmically, as our flagellate ancestors did. When we have passed our prime, our units keep their rhythmic reconstruction; only now, because we are land-animals and must not grow any bigger for fear that our limbs should snap, the rhythm or the chemical change is readjusted, so as only each beat to add as many molecules as we use up between the beats. But the adjustment is not perfect, so that when we have done growing our protein units do not keep absolutely constantthey lose a little each beat on the balance of gain and expenditure So that as we grow older our muscles shrink, and our nerves shrink, and our cartilages shrink, and our brain shrinks, and we become what other people call 'semile', and at length we die—a thing which none of our twelve thousand million flagellate ancestors ever did.

Incidentally, I believe that to that same metabolic rhythm, inherited from the flagellates, we owe our sense of time, so that our appreciation of dancing, poetry, and music shows that we are still

flagellates at heart.

# Obituary.

MR. E W. FERGUSON.

SCIENTIFIC circles in Australia have suffered a great loss in the death at Walnut great loss in the death at Wahroonga, New South Wales, on July 18 last, of Dr. Eustace Ferguson. Eustace William Ferguson was born at Invercargill. New Zealand, in 1884, the son of the distinguished divine, Rev John Ferguson of St Stephen's, Sydney, and when an undergraduate of the University of Sydney showed a passion for natural history. He was encouraged to collect coleoptera by Mr. George Masters, Curator of the Macleay Museum, in whose room I first made his acquaintance. Graduating in 1908 with honours in medicine, he showed an unusual knowledge of that side of his work which dealt with zoology and microbiology. He joined the Linnean Society of New South Wales in 1909 and contributed his first entomological paper on the Phalidurinæ, or ground weevils of Australia, in which group he became the authority; in all he published fourteen papers on the group, papers that were distinguished by their lucidity and judgment.

Joining the Department of Health of New South Wales as pathologist, Ferguson succeeded Prof. Cleland as chief microbiologist; and in logical sequence his later entomological work took a medicinary turn. He was soon keenly engaged in the study of mosquitoes, biting flies (Tabanidæ), fleas, and ticks. Here, as in the field, he showed a remarkable power of close observation, which, combined with a retentive memory, enabled him to recognise at once any form, however minute, that he had once examined. As the companion of many a delightful collecting trip, I have never met his equal for keenness of sight and notice of detail in natural objects.

Ferguson possessed a wide knowledge of Austrahan birds—whether on land or sea From 1915 until 1918 he served in the Medical Corps of the A I.F. in France, Egypt, and Palestine, using his opportunities to visit the Natural History Museum to study types of Australian insects; while in the East he was greatly interested in the history and archæology of those lands He contributed some half dozen papers on the Diptera—chiefly on the Tabanidæ and Syrphidæ—to the Linnean Society of New South Wales, and used his influence with other specialists to communicate some sixteen valuable papers by them to the same society between 1922 and 1927—papers largely founded on material supplied by himself.

Ferguson was a member of the council of the Linnean Society of New South Wales from 1921, and its president in 1926—during the November of which year he was attacked by his fatal illness, actually writing an able presidential address, "A Review of Medical and Veterinary Entomology in Australia," on his sick-bed He was also a member of council and president in 1922 of the Zoological Society of New South Wales, his address containing a strong plea for a biological survey of Australia. In his Department he organised "Tests for the Susceptibility to Diphtheria," and wrote a valuable Report on Dengue Fever. He leaves a widow and six children, five sons and a daughter.

H. J. CARTER.

#### Mr. S. R. Wilson.

THE news of the accidental death, at the early age of forty-five years, of Sidney Rawson Wilson while carrying out an experiment with nitrous oxide has given a painful shock to his many scientific and medical friends

Wilson was the son of Arthur Cobden Jordan Wilson, of Penistone He had a brilliant career as a student at Manchester, during which he obtained the Junior and Senior Platt Physiological Exhibitions and the M.Sc (Vict.) in physiology. Thus early he showed an interest in physiology which remained unabated throughout his life. He afterwards took the M B. degree, both at London and at Manchester, in both cases with honours, and the F.R C S. Edin

Professionally, Wilson was one of the first to make anæsthetics his speciality, and he always endeavoured to combine scientific investigation along with its practical applications He developed the use of the combined administration of oxygen and nitrous oxide for prolonged anæsthesia and introduced improvements in the method of ether The use of carbon dioxide as a administration respiratory stimulant, the importance of which has been emphasised by Yandell Henderson in America, was another of Wilson's contributions to practical anæsthetics. This year he published a paper on ether 'convulsions, the first scientific contribution to the elucidation of this new and dangerous phenomenon

Although previously noted in workers in paraffin refineries, Wilson collected evidence so early as 1906 of the occurrence of cancer of the scrotum in mule spinners. His work on this disease won the Tom Jones Surgical Scholarship in 1907. In 1922 he published a joint paper with Mr. A. M. Southam on this condition, and in 1926 the report of the Home Office Committee on mule spinners' cancer gave him credit for this pioneer work.

News and Views.

THE notice of Dr. Gustave Geley's book on "Clairvoyance and Materialisation," in NATURE of July 23, seems to have been understood by some readers as signifying acceptance of the demonstrable existence of what is known as 'ectoplasm.' Mr. Campbell Swinton expressed the general scientific attitude upon this subject in a letter to NATURE of Aug. 27, and the reviewer, "W. W. L.," then explained that what were described as "facts of experience" in the notice are not necessarily scientific facts capable of being repeated and demonstrated at will. Whether statements about psychical manifestations related by uncritical observers, or similar evidence of 'ectoplasmic' structures, are accepted as 'facts' at all, depends largely upon the tendency of the listener or reader to believe or to doubt. The distinction is aptly drawn by Cowper in his poem "Conversation" in the words:

On the mauguration of a new course in human physiology in the Manchester School, Wilson gave, although in the midst of many professional demands, unstinted help in the development of this teaching and in the carrying out of both human and animal experiments These led him to try out fearlessly their results on his own person. He had early this year maugurated research on the problem of how far nitrous oxide possesses specific anæsthetic properties apart from its action as an oxygen diluent in producing anoxemia. Indeed, it was this work that led him to undertake the experiments which resulted in the fatal accident and deprived the Manchester School of an untiring and intrepid worker.

Wilson took a deep interest in the special senses and in the physiological interpretation of hypnosis. Recently he had initiated work on the retinal sensitivity to the red end of the spectrum, in the course of which he discovered some remarkable phenomena and was engaged in their elucidation during the early part of this year. Recognition of his work by American colleagues gave him great pleasure, and he did much to open up co-operation between the workers in the two countries Besides contributing to the medical journals he took a large part in the foundation of the British Journal of Anæsthesia. He leaves a widow, son, and daughter to mourn his loss.

WE regret to announce the following deaths:

Dr. Bruce Fink, since 1906 professor of botany in Miami University, an authority on lichens, on July 10, aged sixty-five years.

Sir William Glyn-Jones, from 1919 until 1926 secretary of the Pharmaceutical Society of Great

Britain, on Sept 9, aged fifty-eight years. Prof. R. A. Lehfeldt, professor of economics in the University of the Witwatersrand, Johannesburg, since 1917, and formerly professor of physics in East London College and also in the South African School of Mines and Technology, aged fifty-nine years.

Assertions as to the real nature and physical pro-

perties of 'ectoplasm' are received by most natural philosophers in the sceptical frame of mind expressed in these lines. So much attention has, however, been given to the subject in recent years that we invited Dr. Fournier d'Albe, who translated Schrenck-Notzing's "Phenomena of Materialisation" (see NATURE, Nov. 18, 1920, p. 367), to contribute an article upon the actual evidence for the existence of what has been alleged to be an incipient type of matter; and his contribution appears elsewhere in this issue. It will be seen from this article that Dr. d'Albe regards all the alleged phenomena of ectoplasm as spurious. This conclusion of a physicist who has devoted many years to psychical research and spiritualism must carry more weight in a court of natural science than that of many witnesses not possessing his experience in careful observation and cautious conclusion.

In Heft 4, Bd. II. (1927) of the Zeitschrift für kritischen Okkultismus, Dr. d'Albe has supplemented

<sup>&</sup>quot;Can this be true?" an arch observer cries:
"Yes" (rather moved), "I saw it with these eyes."
"Sir! I believe it on that ground alone;
I could not had I seen it with mine own."

his unfavourable report of the alleged mediumistic phenomena occurring with the Irish Goligher Circle which he published in 1922 (see NATURE, Feb. 3, 1923, p 139) In the present note he comments on the inadmissible character of Dr. Crawford's interpretation of certain of the photographs obtained by the latter. In one case the supposed 'teleplastic' structure, which Dr. d'Albe suggests was probably made of chiffon, is shown in the act of partially levitating a small table Crawford supposed that this structure emerging from the medium was pushing the table away from her; whereas Dr. d'Albe shows that the table's centre of gravity is such that the top of the three-cornered piece of chiffon is merely attached to the lower portion of the table top, and is preventing the table from toppling over instead of supporting it.

The weather during August in Great Britain and Ireland was noteworthy on account of the excessive rainfall in all districts excepting northern Scotland, especially in the Orkneys and Shetlands, where Lerwick had less than half the normal total for August. There were two fine periods—one near the beginning of the month and the other at the end. Rain, however, occurred on most days, and thunderstorms were numerous and widespread. At many places rain fell on more than 20 days; London had 7 days free from rain and Dublin only 4. Exceptional rainfalls were recorded in many districts, particularly from Aug. 5 to Aug. 12, 3.47 in. being recorded at Glen Lyon (Invermearan) on Aug 5, and 2 21 in. at Marchmont on Aug. 8. In Perthshire and the Lothians the rainstorms were of unusual intensity on Aug. 8 and 9. In Edinburgh the month was the wettest August since 1770, with the exception perhaps of the years 1829 and 1877 In parts of northern and north-western England and Wales, monthly rainfall totals exceeded more than twice the normal. Harrogate with 7.5 in., and Ilkley with 82 in., had nearly three times the normal. The week ending Aug. 20 was the wettest in most districts, and the total general rainfall in the Midland counties of England was nearly four times the normal during this period. In some parts of Northern Ireland there was a deficiency of rainfall, but at Mallarany 2.14 m. fell on Aug. 6 and 273 on Aug. 14. Expressed as a percentage of the normal August rainfall for the period 1881-1915, the monthly total this year for England and Wales was 155 per cent., while that for the year 1917 was 210 per cent., and for 1912, 216 per cent. It will be seen, therefore, that in the years 1912 and 1917 August was even wetter than it was this year.

England, or that part of it lying to the south of a line joining the Bristol Channel to the Wash, experienced a period of recurring rains from Sept. 13-15. The rains were caused by two depressions, one moving south-eastwards from Ireland on Sept. 13 and the other eastwards up the English Channel a day later. The largest daily total of rain occurred between the mornings of Sept. 14 and 15. During this period Brighton had 2.52 in.; Southsea, 2.41 m.;

Norwich, 2 26 m; Winchester, 2 21 m, Southampton, 201 m; Littlehampton, 197 m., Marlborough, 190 m; Bognor, 189 m, Yaimouth, 182 m; Leafield and South Farnborough, 1.73 m.; Ventnor, 169 in; Hellingly, 166 in, Worthing and Bath, 165 m.; Bournemouth and Weymouth, 161 in. In the area considered, with the exception of a small narrow strip near the south-east coast, the day totals were well above an inch in most The intensity of the rainfall during the three rain days, Sept. 13, 14, 15, becomes more apparent when the totals for the three days are taken (the normal for the whole month of September for the period 1881-1915 is given in brackets after each station mentioned); Norwich, 384 in (214 in), Yarmouth, 3 73 in (1.96 in.), Marlborough, 3 15 in (2·10 m); Brighton, 3 08 m. (2·05 m.); Southsea, 265 m. (217 m.), Bognor, 260 in. (207 m.); Lowestoft, 2 55 m. (1 96 m). Many other places had 15 in.-2.5 in during the period.

THE recent fatal accident at Newport, where a boy was killed when trying to listen to the broadcasting, has created a certain amount of uneasiness among users of radio apparatus. The cause of the accident, however, as shown at the inquest, is fairly obvious. An old piece of badly worn flexible cord was in use for connecting a table lamp to a lampholder by means of an adaptor. The flexible cord was wound round the knobs of two of the bedposts, and both the bedstead and the metal of the portable lamp were 'alive.' A bad shock, therefore, would be obtained by touching the metal of the bedstead and anything connected with the earth, for example, a damp wall, a metal beam, or a gas fitting. The boy had put one of the wires connected with his crystal radio set into his mouth under the impression that this would make him hear better. This wire was, as usual, connected with the earth, consequently, if he touched either the metal bedstead or the lamp he would receive a tremendous shock, which would almost certainly be fatal. Apparently the electric lighting had been installed in an unsatisfactory way. but this had little to do with the accident, which was due to the defective flexible cord The accident has very little connexion with broadcasting receiving sets. It proves, however, the necessity of care being exercised when a receiving set is connected with the lighting mains. To get a shock it is necessary for the lighting circuit to be defectively installed and for the individual to be making good contact with the earth, standing, for example, with damp boots on a damp floor. Flexible cord for a reading lamp is often in contact with a metal bedstead. If the cord be defective the metal may become alive and serious shocks will be obtained if any one touches it and anything connected with earth; the less the resistance to earth the greater the shock. a state of affairs should always be remedical at once.

Using an antenna only 25 feet long which emitted waves having a frequency of 9140 kilocycles (32.8

metres), an experimental radio station in America has been heard all over the world. It has been picked up and rebroadcast in Australia. These high frequency waves have the peculiarity that they seem to skip over long distances and then for greater distances become clearly audible again. We learn from a Daily News Bulletin issued by Science Service, of Washington, that the engineers of the General Electric Co at Schenectady, when experimenting with waves having a frequency of 60,000 kilocycles (5 metres), have discovered new and interesting phenomena The preliminary tests made showed that these signals produced a shadow effect very similar to that produced by light. A small hill, for example, prevented reception in the valley beyond, although the transmitting set was fifty feet above the level of the ground. Using a power of only 60 watts, which is the power taken by an ordinary electric lamp, it was possible to pick up the signals 32 miles away. All the tests were made in the day time, but further tests with higher powers at night time are being carried out. A receiving set for these waves is being placed on the top of the Woolworth Building in New York City, which is 135 miles away. This building was selected because there is an uninterrupted line of 'vision' between it and the Schenectady sending set The region of the spectrum between these rays and the invisible heat and infra red rays has still to be explored.

THE success of broadcasting has led many to speculate on the possibilities of other applications of Hertzian waves Broadcasting appears to be the culmination of the development of the non-directional property of these waves. Developing the possibilities of directional transmission is attracting a great deal of attention at the present time. Dr. Dellinger, in an address printed in the Journal of the Franklin Institute for August of this year, makes some interesting suggestions. A fair amount of success has been attained in concentrating a beam of radio waves in one direction. With short waves, beams have been transmitted thousands of miles. These waves exhibit the phenomenon known as 'skip-distance,' that is, beyond a short distance round the transmitting station, there may be a zone of several hundred miles where the signal cannot be received. Beyond this there is a zone of a definite width where the signals can be heard quite clearly. If it were possible, therefore, to confine such waves sharply along a given line from the transmitting station, there would only be a limited area on which the signals from the transmitting station could be received. By controlling the frequency and the direction it would thus be possible theoretically to communicate exclusively with one definite locality on the earth's surface. At present this is impossible, as the beam is not sufficiently concentrated. Dr. Dellinger thinks that the idea of transmitting substantial amounts of power by radio is quite Utopian. Engineers doubtless could build a radio station which could transmit enough power to light and heat a house several miles away, but the commercial efficiency would be hopelessly low. Directive radio has proved of great value in aviation and in navigation. It appears to have a great future for these purposes. It has not been very successful so far for individual communication, and it probably will never be successful for power transmission

AT the annual conference of the National Veterinary Medical Association, held at Torquay last week, tuberculosis was the subject of an important discussion. Major B. de Vine, of the Birmingham Veterinary Department, pointed out that large sums are being expended annually upon sanatoria, hospitals, and clinics for the treatment of human tuberculosis. These costly measures might soon become unnecessary if legislation provided powers to deal with the disease in cattle during its early stages. Prof. Hobday, Principal of the Royal Veterinary College, said that although human pulmonary tuberculosis is becoming less and less prevalent, much abdominal tuberculosis, particularly in children, remains, and is always derived from tuberculous infected milk If, therefore, cattle could be freed from the disease, the lives of 10,000 children who die yearly of the infection might be saved. He alluded to the work of Calmette and Guerin in France, who have prepared an attenuated living culture of the tubercle bacillus as a preventive vaccine against the disease, which has been used experimentally on calves with wonderful success, and to the work of Dr. Nathan Raw in Great Britain, who is carrying out a similar method with a dead vaccine. If these measures were equally successful when applied to man, human tuberculosis might well become a thing of the past. Both Prof. Hobday and Prof. Wooldridge emphasised the importance of medical men and veterinary surgeons working in collaboration for the general good.

The third annual Norman Lockyer lecture of the British Science Guild will be given by the Very Rev. Dean Inge on Monday afternoon, Nov. 21, in the Goldsmiths' Hall, London.

THE seventy-second annual exhibition of the Royal Photographic Society of Great Britain was opened on Sept. 12, at 35 Russell Square, W.C.1, and will continue open until Oct. 8. Admission is free. The exhibition includes this year, in addition to more than one thousand selected photographs of various subjects, many of them of great beauty and interest, a number of pieces of historic and modern scientific apparatus and photographic accessories. Different sections of the exhibition are devoted to natura, history, photomicrography, radiography, astronomical and aerial photography, and technical applications, including meteorological, geological, and metallurgical photography and useful photographic devices. A special number of the Photographic Journal (price 1s. 9d, post free) contains authoritative articles on different sections of the exhibition and many reproductions of pictures, including twenty from the natural history section.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A demonstrator in mathematics in the Royal College of Science —The Secretary, Imperial College of Science and Technology, South Kensington, S.W.7 (Sept. 27). An open research fellowship in the department of Coal Gas and Fuel Industries of Leeds University—The Clerk to the Senate, The University, Leeds (Sept. 30). A lecturer in dental anatomy (including comparative anatomy), physiology, and histology at the Dental School, Cairo—The Director of the Dental School,

Cairo (Sept. 30). A second demonstrator (medically qualified) for the department of physiology—The School Secretary, Middlesex Hospital Medical School, Mortimer Street, W.1 (Oct. 8). An assistant master to teach biology—The Secretary, City of London School, Victoria Embankment, E.C 4 (Oct. 10). A biologist at the Dove Marine Laboratory, Cullercoats—The Registrar, Armstrong College, Newcastle-upon-Tyne (Oct. 13). A district lecturer in agriculture and an assistant lecturer in dairy husbandry in the University of Leeds—The Registrar, The University, Leeds (Oct. 15).

### Our Astronomical Column.

RECENT SUNSPOTS.—The large sunspot, to which attention was directed in Nature of Aug. 27, p. 311, was seen again as it crossed the disc on Sept. 3-16. Although accompanied by a considerable area of bright faculæ, the spot itself had diminished to about one-fifth of the area it presented during its first appearance. It may be noted that the magnetograph traces were somewhat disturbed between Sept. 7 and 15, more particularly on Sept. 9 and 10. On Sept. 10, at  $21\frac{1}{2}$  hr., a wave was recorded by the horizontal force magnetograph at Abinger, Surrey, which represented a change in H.F. of  $250~\gamma$  within 20 minutes. The sunspot already referred to was on the central meridian on Sept. 10.1.

In brief intervals of sunshine on Sept. 14, a naked-eye group was detected near the central meridian. A telescopic view showed a large stream (two large spots with smaller companions between them) which had grown from a few tiny spots photographed near the sun's east limb on Sept. 9. North of this group, another of about half the size was also developing on Sept. 14 and was still increasing when observed again on Sept. 17. These two groups may be looked for at their return to the sun's east limb on Oct. 4 at position angles 135° and 127° respectively from the north point of the image. The larger of these two groups is added to the list of naked-eye spots as follows.

No. Date on Disc. Central Meridian Passage Latitude. Area on Sept. 14. 9 Sept. 9-20 Sept. 14.3 19°S. 1/800 of hemisphere.

The Daylight Fireball of Sept. 7.—Mr. W. F. Denning writes: "This object appears to have attracted a great number of spectators. Some excellent descriptions have been received of its path, direction, and aspect. Observers agree in stating that it pursued a long, horizontal flight from east to west, and that it exhibited a bright bluish-green colour. Reports have come from the south of England, France, and Jersey. The following results have been obtained from a comparison of the observational data:

The radiant point was rising on the eastern horizon and the meteor traversed its extensive course with little change in its height except perhaps near the end of its trajectory, when it apparently exhibited an inclination earthwards."

A SPECTROSCOPIC DETERMINATION OF THE ABERRATION CONSTANT.—In a paper on this subject in *Mon*.

Not. R.A S. for May last, Dr. H Spencer Jones recalls that Sir David Gill's first thought when Mr. Frank McClean offered the Victoria telescope to the Cape Observatory was that it would give a determination of the solar parallax by the annual changes in the radial velocities of the stars. Such a determination was completed in 1908 and gave 8".800±0".006 for the parallax. A new determination has been made from subsequent plates taken between 1908 and 1926. Slightly different values are obtained according to the manner of treating stars with variable radial velocity, but the extreme range is only 0" 003. The adopted result is 8" 800 ± 0" 004 using the same terrestrial radius and velocity of light as in 1908, but on substituting Hayford's spheroid and Michelson's new value of the velocity of light, it becomes  $8^{\prime\prime}\cdot803$ . The corresponding value of the constant of aberration is  $20^{\prime\prime}\cdot475\pm0^{\prime\prime}\cdot010$ . The agreement of the two independent determinations is very satisfactory.

METEOR CRATER, ARIZONA —This remarkable formation, recalling a lunar crater, was formerly known as Coon Butte, and lively discussion took place on its origin; the meteoritic origin was disputed by many experts, including the late Sir Archibald Geikie. Evidence in its favour has, however, accumulated, and it is now so widely accepted in America that the name has been altered to Meteor Crater The Scientific American for September contains an interesting article on it by D Moreau Barringer, junr Some of his principal conclusions are as follows; the amount of rock crushed and displaced was 350,000,000 tons is estimated that this would give a mass of 10,000,000 tons to the falling meteor, if in one piece, this would mean a diameter of 400 feet, but reasons are given for believing it to have come as a swarm of smaller masses. It was at first assumed that the fall was vertical, since the crater is round; it is now thought to have been oblique, and in fact a drill hole on one side of the crater revealed numerous meteoric masses; this search is being continued. The date of the fall is put between 700 and 5000 years ago. A tree growing on the rim of the crater, with some 700 rings, gave the lower limit; the other was fixed by the amount of erosion. The meteors must have been much more concentrated than in the ordinary meteor shower; we may conjecture that it was the actual head of a comet that struck the earth. The small stellar nucleus of Pons Winnecke's comet, seen at its recent approach, suggested considerable concentration, though not so much as in this case.

Meteor Crater has done a good deal to revive the meteoritic theory of the lunar craters; their resemblance is so close that a similar origin in each case is strongly suggested.

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#### Research Items.

THE LIFE-HISTORY OF THE NORTH SEA PLAICE.— The Ministry of Agriculture and Fisheries has recently issued Fisheries Notice, No. 12, which sets out in non-technical language our present knowledge concerning the life-history of the plaice in the North Sea, and of the effect of fishing upon the stock of plaice. Within the compass of an eight-page pamphlet, the author has succeeded in presenting an admirable summary, not only of the known facts, but also of the methods by which the facts have been established. Section 4 deals with the all-important question of the extent to which man takes toll of the quantities of place in the North Sea. The results of marking experiments have shown that out of 1000 living plaice marked and released, 250-300 are recaptured inside a year from the time of marking. It has been estimated, on the basis of all the English marking experiments carried out before the War, that if we start with 1000 male plaice and 1000 female plaice, about  $6-7\frac{1}{2}$  inches long and 2-3 years old, their numbers will decrease in succeeding years as follows:

At the end of the first year, 788 males and 844 females.

,, second ,, 444 ,, ,, 573 ,, ,, third ,, 236 ,, ,, 329 ,, ,, fourth ,, 125 ,, ,, 189 ,,

Thus, at the end of four years, only about one plaice in seven is left. The careful study of market statistics of commercial landings of plaice in the years before and after the War provides an object-lesson on a big scale of how fishing affects the stock of fish. If too many fish are left on the ground owing to there not being enough fishing, the ground gets crowded and the fish do not grow so fast—this actually happened during the War. So, too, when a new ground is fished for the first time, the fish caught are generally large and thin and old; but as this old accumulated stock is reduced by fishing, the survivors begin to thrive and grow faster, so that fishing improves the growth-rate of the individual fish. But if the fishery is continued on too big a scale, the fish, fast-growing though they may be, do not grow up in sufficient numbers, with the result that the medium and large fish becomes very scarce.

Freshwater Eels in the Pacific Area.—In order to complete his well-known work on the distribution and biology of the freshwater eels, Dr. Johs. Schmidt last year undertook a voyage to the Pacific to study the tropical species in their native habitat. In an article entitled "Les Anguilles de Tahiti" (La Nature, No. 2765, July 15) he gives a résumé of his investigations, and the new methods he has employed in the identification of species, illustrated by excellent diagrams and photographs. Tahiti was chosen as a centre largely because Darwin's account of the island in his "Journal of a Naturalist during a Voyage round the World in H.M.S. Beagle," showed its suitability for the purpose, and also because the three species of eels which occur there in great abundance are widely distributed in the tropical Pacific. The species are found in very different conditions, their colour harmonising with their surroundings. Anguilla obscura, dark and unspotted, lives in the mud and stagnant waters of shallow ponds; the spotted A. megastoma and A. mauritiana, both of which attain a great size, are found on the pebble and gravel beds of the rivers, the first in the rapid streams of the mountain districts and the other in the rivers nearer the Dr. Schmidt refers to the numerous native legends connected with the eel, and especially to the story of a giant race of eared eels peculiar to Lake

Vaihiria, to which his attention was first directed by Sir John Murray. This legend has proved easy of explanation. The so-called 'ears' have nothing to do with the auditory organs, but are simply the two pectoral fins just behind the head, one on each side, small and not easily seen in the young animal, but deeply coloured and very noticeable in the adult. The two specimens collected in Lake Vaihiria by the Challenger Expedition, and now in the British Museum, were examined, and proved to be nothing more than very large examples of A. megastoma and A mauritiana. With regard to the migrations of the Pacific eels, Dr. Schmidt states that it is not possible to determine their breeding-places with any exactitude unless a research vessel equipped for the purpose is employed. He was able, however, to make a series of observations on one of the species, A. mauritiana, from which he concludes that this species at least differs very greatly from the European eel in its breeding habits, and that it forms two distinct races, each with a different centre of reproduction.

Damage by Marine Crustaceans.—A fresh example of serious damage done to submarine timbers by crustaceans has been described by Dr. James Ritchie (Scottish Naturalist, 1927, p. 37). Dock-gates of yellow pine and greenheart were placed in Methil Docks, on the Firth of Forth, in 1897, and by the autumn of 1925 they had become so dilapidated that they were removed and replaced by dock-gates of steel. The damage was entirely due to the boring of Limnonia lignorum and Chelura terebrans, small isopod and amphipod crustaceans. Of these, Chelura was the most numerous and most serious pest, and in typical portions of the damaged timbers it had caused the removal of as much as 13 inches of wood, the rate of damage averaging more than one-third of an inch a year. Chelura has not hitherto been found in the Forth estuary, although in association with Limnoria it has a world-wide distribution, and the suggestion is made that its presence at Methil may be due to a relatively recent importation in timber from another port, and that there is a possibility of a colonisation of the Firth of Forth from the Methil centre by this destructive pest.

NORTHERN CTENOPHORA.—Dr. Thilo Krumbach, in describing the Ctenophora of the North Sea and Baltic ("Die Tierwelt der Nord- und Ostsee," Lieferung 7, Teil 3, f 1. Leipzig: Academische Verlagsgesellschaft m.b.H., 1927), gives a very able account of the group, emphasising the general biology although in no wise neglecting the morphology. Ctenophores have now a peculiar significance as they are known to be such carnivorous feeders that they must be regarded as serious enemies to young fishes, both directly by eating them and indirectly by swallowing in huge quantities the food which the fishes themselves might have eaten. They are thus not only interesting in themselves, but also must be taken into account by all fisheries workers. Beroe alone may be regarded as a friend as it devours other etenophores. The author only allows three species in the area covered :-Pleurobrachia pileus, Bolinopsis infundibulum, and Beroë cucumis, all well known; occasional so-called closely related species recorded by other zoologists being included in these. As visitors he records Mertensia ovum from the Arctic regions and Cestum veneris from the warmer seas. This arrangement is satisfactory and simple, for it seems right to bring together such evidently closely related forms which,

for example, are described as separate species from the Mediterranean and the present area. *Bolinopsis* infundibulum and *B. hydatina* are thus regarded as synonymous, an arrangement with which we heartily agree, as the chief difference is in the windings of the lobe canals, which certainly in the British form can vary to a large extent according to age

MARINE PLANKTON IN RELATION TO PHYSICAL AND CHEMICAL FACTORS.—Miss S M. Maishall and Mr. A. P. Orr, working from the Marine Station, Millport, have made a careful and elaborate study of plankton production in the Clyde area, and particularly in Loch Striven, which was visited weekly for the greater part of 1926. The results are given in Jour. Marine Biol. Assoc., 14, 4, May 1927, pp. 837-868 Simultaneous observations were made on the quantity and character of the plankton, dissolved oxygen saturation, phosphates, salinity, pH, nitrates, and nitrites, meteorological conditions were also taken into account. close relation was found to exist, at least for the surface layers, between the quantity of diatoms and the changes in pH, dissolved oxygen and phosphates. The usual spring maximum of diatoms occurs, but there are others later in the year, more numerous than in the open sea, due apparently to the more frequent mixing of the water in the Loch. The conditions leading up to the spring maximum are discussed, and the conclusion reached that neither amount of sunlight nor rise of temperature is the decisive factor. paper contains much valuable data, and is well illustrated by some twenty graphs; it is important particularly in relation to the work of Atkins in England and Gran in Norway.

TEST FOR INCIPIENT PUTREFACTION OF MEAT.-Fresh meat is such an important article of diet that some rapid test that would indicate whether butcher's meat is strictly fresh or otherwise is very desirable, and many investigations have been made in order to devise one. Mr. Ralph H. Weaver has recently published the results of investigations into this question (Technical Bull., No 79, Agricultural Experiment Station, Michigan State College) Fresh Hamburger steak was employed, and Mr. Weaver finds that neither the number nor the characters of the micro-organisms present prove a sure guide. Finally, a test was devised which has given promising results. One gram of the meat is placed in a test-tube with 10 c.c. of a standard meat broth. A strip of lead acetate paper is suspended in the tube, which is then incubated in a partial vacuum at 37° C. and the time of appearance of blackening of the acetate paper, indicating the presence of hydrogen sulphide, is noted. Good meat gave a positive result in 7-10 hours, stale meat in 2-5 hours.

Cretaceous Mollusca from Japan.—A narrow belt of Cretaceous beds, known as the Sanchû Graben, occurs faulted down between Palæzoic rocks in the main island of Japan to the north-west of Tokyo. These beds, representing several stages of the Lower Cretaceous, have been subdivided into five groups, and a recent paper by H. Yabe, T. Nagao, and S. Shimizu deals with the fossil Mollusca of the upper three (Science Repts., Tôhoku Imp. Univ., Sendai, Ser. 2, vol. 9, No. 2). Eleven species of Ammonites, six of Gastropoda, and twenty-eight species with two varieties of Pelecypoda are described, a large number as new, and well illustrated.

The Geology of St. Helena.—The full report of Prof. R. A. Daly's recent investigation of St. Helena has now been published in the *Proc. Amer. Acad. Arts and Sci.*, vol. 62 (2), 1927, and is a geological document of great importance and interest, adding as it does to

our still meagre knowledge of the deep-sea islands. The emerged part of the island is a composite volcanic structure made up of two domes, each of which has been built up by lavas from a network of fissures larger dome has been punctured by a dozen pipes of phonolite and alkali-trachyte. Basalt is otherwise by far the commonest rock. Unlike Ascension, St. Helena provides no evidence of a continental type of foundation. From the point of view of isostasy the island is remarkable, for despite the fact that it appears to be largely uncompensated and therefore represents a heavy load carried by the earth's crust, it shows no sign of having subsided during a period of the order of a million years. Stability in recent times is proved by the presence of the five-metre wave-cut bench which here, and in many other parts of the world, indicates a eustatic fall of sea-level that probably took place some three thousand years ago. No new facts bearing on the age of the island have been discovered, but the geological history is in accordance with Wallace's deduction from the fauna and flora that the island dates back to at least the Miocene.

THE ORIGIN OF ANORTHOSITE.—A noteworthy contribution to the evidence bearing on the still unsolved problem of the origin of anorthosites is made by J. B. Mawdsley in his report on the St. Urbain area of Quebec (Mem. Geol Survey Canada, 152, 1927). The mass described has a smoothly ovoid form against a series of granites and diorites The latter overlie the series of granites and diorites anorthosite complex and in places hold blocks of basic anorthosite. Within the anorthosite body itself more albitic phases cut and enclose blocks of an earlier and more anorthitic phase. All the rocks contain fragments of large andesine crystals, suggesting that the granite-diorite series and the anorthosites are closely related. Foliation in both series, in a narrow zone following the main contact, further suggests relative movement between them while each was still in a condition in which flowage was possible. Mr. Mawdsley suggests that this puzzling association implies that at least the later andesine-anorthosite advanced into its present position as a liquid This conclusion is at variance with the well-known hypothesis due to Bowen, according to which anorthosites have been formed in situ by the collection of felspar crystals from a gabbroid magma, and not from a magma of their own composition. If sound in principle, as it appears to be, Bowen's views must be modified to allow for subsequent flowage of the crystal aggregate on a scale, and with an ease of movement, not previously thought to be necessary.

THE EVAPORATION OF WATER.—Volume 4 of the Japanese Journal of Astronomy and Geophysics contains a contribution on this subject by Mr. T. Hirata of the Forestry Experimental Station. His evaporimeter was a polished copper pot 20 cm. in diameter and 10 cm. deep filled with water to a depth of 2 cm. and placed on a sodded mound 20 cm. high. The height of the water was observed each day at 10 A.M. (This appears to be the usual instrument of the Japanese meteorological service.) The observations are consistent with the relation :-- depth of water evaporated =  $a(V - v)\sqrt{W}$  where a is a constant, V the saturation vapour pressure at the temperature of the surface water, v the actual vapour pressure in the arrabove, and W is the velocity of the wind over the surface. The value of a depends on the amount of sunshine and the heat conducted to the pot by its surroundings. It is reduced by an increase in the size of the pot. The effect of sunshine dimmishes with altitude of the surface above sea-level up to 700 metres and then becomes nearly independent of altıtude.

LIGHTING IN FACTORIES.—In the Journal of the National Institute of Industrial Psychology (vol. 3, No. 7) is an article on lighting in the factory by Mr. A M. Hudson He maintains that although improvements in lighting have been made in recent years, yet many factories still fail to make the best use of daylight, and that artificial lighting is generally below the standards that modern research has shown to be physiologically desirable. He discusses the effect of dirty windows—unfortunately far too common—the relation of under illumination and eyestrain, the effects of inadequate artificial light in reducing output and increasing strain. He points out the importance of a study of glare, concerning which there is much work to be done. He pleads for a much greater use of photometers in factories, particularly in fine-process and inspection depart-The subject is one of extreme importance, and it seems clear that while there is room for much more scientific work on the problems of lighting, there is also room for a wider application of what is already

ACTIVE NITROGEN.—The August number of the Physical Review contains several papers on active nitrogen. In one, P. A. Constantinides has described experiments performed by him under the direction of Prof. Dempster, from which he concludes that it is not ionised, and suggests that its essential constituent is an excited diatomic nitrogen molecule, with an energy of activation equivalent to about ten volts. In a second communication, E. O. Hulburt and W. H. Crew state, inter alia, that active nitrogen can be formed under conditions in which it is unlikely that there is any considerable dissociation into atoms, whilst in two further papers, Prof. Mulliken and some collaborators have given a detailed analysis of the  $\beta$  bands of nitric oxide. These were produced in the nitrogen afterglow, and photographed in the second order of a 21-ft. Rowland concave grating. The mass of information which they have obtained is important both for the light which it throws on the structure of nitric oxide, and also for the test which it affords of theoretical predictions about the nature and probability of the various quantum transitions which occur in diatomic molecules.

CHROMIUM - PLATING. — The Chemiker - Zeitung of Aug. 10 contains an account of recent developments in the art of chromium-plating, which has hitherto been attended with serious difficulties. Not only has it been possible, by the use of suitable electrolytes, to reduce both the quantity and the density of the current to reasonable dimensions, but also the disturbing effect of the hydrogen evolved at the cathode has been recently eliminated, without the application of heat, by a new process patented by Dr. von Bosse. It has been ascertained that the amount of hydrogen occluded by the chromium increases very considerably with increasing current-density and frequently cracking and scaling of the deposit takes place. The chromium-hydrogen alloy thus produced can, however, be broken down by the application of a hightension alternating current in a highly evacuated chamber, when light is emitted and in the course of a few minutes the hydrogen is completely eliminated as gas The end of the process can be recognised by observing the change which takes place in the character of the light emitted. The necessary apparatus is supplied by the firm Langbein-Pfanhauser of Leipzig and Vienna.

Adsorption on Charcoal.—Interesting experiments on the adsorption of acids from solution by ash-free charcoal are described by E. J. Miller and S.

L. Bandemer in the July number of the Journal of the American Chemical Society. The results show that acids adsorbed on charcoal are incapable of inverting sucrose in solution. It is suggested that the adsorbed acids are in an undissociated state, that (contrary to existing ideas) the adsorption of acids does not imply a high concentration of hydrogen ions around the adsorbent, and that some theories of adsorption and catalysis are seriously affected by the results.

THE ATOMIC WEIGHT OF SCANDIUM.—N. H. Smith describes experiments in the July number of the Journal of the American Chemical Society on the atomic weight of scandium. Anhydrous scandium chloride (ScCl3) was prepared by the action of pure carbon tetrachloride on the oxide at 750°-800°. The material used was pure, and the corrections necessary in Honigschmid's previous determinations, made in 1919 with scandium bromide contaminated with small quantities of scandium oxide formed by the action of the bromide on quartz apparatus, were avoided. A solution of the chloride was almost exactly precipitated with silver nitrate solution from a weighed amount of pure silver, and the slight excess of halogen or silver determined by the nephelometer. The atomic weights of chlorine and silver were assumed as  $35\,457$  and  $107\,880$ , and the average of nine analyses gave Sc = 45 160, in fair agreement with Honigschmid's value 45 099 (earlier values ranged from 43 90 to 45 23). The origin of the materia. used by Smith is not stated.

THE CONSTITUTION OF THE PROTEINS —The behaviour of protoplasm seems very closely bound up with the physical and chemical properties of the proteins, of which protoplasm is largely composed; and some elucidation of the chemical structure of the protein molecule will go far towards clearing up some of the problems underlying the metabolic activities of living cells The mechanism of heredity depending, so far as we can judge, on the specificity of living matter, may possibly also be in some measure explained by structural variations displayed by the proteins. The polypeptide theory of the constitution of the proteins, propounded by Emil Fischer, has long held the field. He conceived proteins as gigantic molecules consisting essentially of several amino acids joined together by means of the peptide linkage —CO—NH—, thus forming a considerably long chain. In Acta Phytochimica (vol. 2, No. 4, Dec. 1926) Prof. Keita Shibata, of the Imperial University of Tokyo, supports the view that the molecules of amino acid anhydrides, which are mostly derivatives of diketopiperazines, are bound together by a force other than ordinary valency, giving rise to a colloidmicell of definite magnitude, the protein molecule. Apparently this new idea suggested itself to investigators through analogy to the now prevalent and well-founded conception of the constitution of the polysaccharides, such as starch, cellulose, glycogen, inulin, which may be regarded as association or polymerisation products of the ground bodies, i.e. anhydrides of simple The theory of the anhydridic structure of protein is now receiving support from various sides. Some of the outstanding evidence from recent experimental work include: (a) Its characteristic colour reaction towards soda-alkaline solution of picric acid (Abderhalden); (b) its oxidation and reduction products (Abderhalden); (c) its rontgenographic properties and the determinations of its molecular weight (Herzog, Troensegaard); (d) the action of hypobromite on it (Goldschmidt); and (e) its racemisation in alkaline media (Levene).

# The Morphology of the Insect Thorax.

By Dr A. D. Imms, Rothamsted Experimental Station

MUCH has been written relative to the morphology of the insect thorax and its appendages, but few of the contributions of recent years have led to any modification of the present-day conceptions of that subject. The whole problem, however, has been re-investigated in a comprehensive memoir by Dr. R. E Snodgrass, whose work is characterised by clarity of deduction and an honest attempt to place the subject on a better foundation In discussing the general problem of segmentation, he takes us back to the primitive soft-bodied ancestors of the arthropods and points out that in such animals the grooves limiting the body-segments coincided with the lines of attachments of the longitudinal muscles. This same condition is still met with in many insect larvæ. Adult arthropods, on the other hand, with their hard exoskeletal body-plates, have acquired a secondary segmentation. This has been achieved by the development of a membranous unchitinised zone just in front of each muscle-bearing intersegmental groove. The function of this flexible area is to admit of freedom of movement and telescoping of the hardened resistent segments. Such membranous areas are commonly regarded as truly intersegmental in position, but, as Janet was the first to demonstrate, the term intersegmental membrane, although justified from its function, is morphologically inexact. Flexibility could not well be at the original intersegmental grooves because the muscles are here attached and demand firm support. The dorsal and ventral regions of these grooves have become converted into internal ridges, which have become fused with the skeletal plates immediately behind them as is shown in the accompanying illustration (Fig. 1).

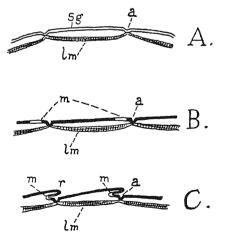


FIG. 1.—Diagram of lengthwise section of portion of a segmented animal (adapted from Snodgrass).

- A. Primary segmentation of soft-bodied animal with segments marked by intersegmental grooves.
   B. Secondary segmentation of an insect with chitinised body-wall and membrane developed in front of the primitive intersegmental
- C. Secondary segmentation accompanied by telescoping of the segments, each segmental plate ending in a posterior icduplication.
  a, primitive intersegmental groove; lm, longitudinal segmental muscle; m, membrane; r, reduplication; sy, segment.

In discussing the morphology of the primitive arthropod limb, Dr. Snodgrass takes as his starting-

<sup>1</sup> Smithsonian Miscellaneous Collections, vol. 80, No. 1. Morphology and Mechanism of the Insect Thorax. By R. E. Snodgrass (Publication 2915.) Pp. 108 (Washington, D.C.: Smithsonian Institution.)

point the hypothetical generalised appendage, which rami—the exopodite and the endopodite Of the three segments into which the protopodite is divided. the first (pleuropodite or subcoxa), he maintains, has lost its power of movement in insects evolving limb came to demand more rigid support, the subcoxa became flattened out and embedded in the wall of its segment as the forerunner of the pleuron. The coxa (coxopodite) was thus forced to replace the subcoxa as the functional base of the lmb m all msects. The hypothetical biramous appendage does not, unquestionably, appear to have been retained in any insect. The only fact that can be construed as evidence of this feature, is the presence of styli on the coxe of the middle and hind legs of Machilis and related genera. It is claimed by many morphologists that these styli are exopodites, whereas a true exopodite is borne on the basipoditoa segment either lacking in most insects or included in the trochanter. Dr. Snodgrass maintains that it still remains to be demonstrated that these organs are other than merely secondary structures. His discussion of the hypothetical evolution of the pleuron is too lengthy to be detailed here, but, in a few words, it may be said that according to the view upheld in his memoir, the original subcoxa became reduced to a basal eupleuron, from which the epimeron and episternum were later derived, and a distal trochantin in immediate contact with the coxa.

With regard to the leg-segments, reference is made to the double trochanter so frequent in the parasitic Hymenoptera. The proximal segment of this region, Dr. Snodgrass believes, is the true trochanter, and he bases this conclusion on a study of the reductor femoris musele. The second trochanter is merely a basal area of the femur, separated off from the main portion of that segment by means of a secondary suture and ridge In the nymphs and adults of the Odonata the structural relations of the double trochanter appear to be quite different, and Dr. Snodgrass brings forward evidence for concluding that, in this order of insects, the two trochanters represent two primary leg segments, as has already been maintained by Verhoeff. In most insects the two trochanteral segments have fused into a single piece

With regard to the tarsus, this region consists of a single segment in holometabolous larvæ as it does in adult Protura, which segment is to be regarded as the propodite of the generalised arthropod limb. In most insects the tarsi are divided usually into five subsegments, and these latter appear to be subdivisions of the single primitive shaft. They have no articular hinges with each other and are never provided with their own special muscles-facts which evidence that these divisions are not true segments. The tarsus is moved, as a whole, by muscles inserted into its base, or by tension of the claw muscles on the tendon which traverses it. The region at the extremity of the tarsus—the 'foot' in usual terminology—consists of a group of organs which were designated the prætarsus by de Meijere. In its simplest form it consists of a median claw-like segment · in this form it occurs in the Protura, in certain Collembola, in caterpillars, sawfly larvæ, and in most beetle larvæ.

Dr. Snodgrass follows de Meijere and regards the prætarsus not as an outgrowth of the last tarsal 'segment,' but as a development of the dactylopodite

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of the generalised arthropod limb. In the Lepismidæ each prætarsus bears three claws and it appears probable that the smaller median claw is the homologue of the original dactylopodite and that the lateral claws of these, and most other adult insects, are subsequent developments. According to de Meijere, the paired claws are outgrowths from the base of the original dactylopodite. One or other of these, on

the other hand, may be secondarily suppressed, as in many of the Anoplura (sensu lat).

In addition to those features already alluded to, this memoir discusses the tergal and sternal sclerites, the origin of wings, the flight muscles, position of the spiracles, etc. These and sundry other problems must be left to the reader who desires to consult this suggestive work first hand.

# Forestry Research in South Africa.

THE research work which is being carried out by Dr. John Phillips at the Forest Research Station, Deepwalls, Knysna, in South Africa, is of considerable interest to practical foresters, whilst at the same time being of botanical value. Dr. Phillips graduated B Sc in forestry in 1922, and his work in South Africa has recently received the recognition of the degree of D.Sc. from the University of Edinburgh. Two recent papers published in the South African Journal of Science for December last, indicate the lines upon which Dr. Phillips is working.

The first deals with the ecology and sylviculture of the monotypic genus Virgilia Lamk, an important tree of seral forest at the Knysna. The tree is said to be of use in sylviculture, affording excellent cover to the seedlings of other forest species. It is readily raised from seed and transplants easily. The Virgilia is one of the fastest-growing native trees at the Knysna, natural stands often requiring thinning. In spite of these important faculties its distribution is restricted, as is that of others of the curious indigenous species of these South African forests. The species is light-demanding, developing best on soils of medium hollard, being susceptible to frost, but capable of resisting high surface-soil temperatures in its seedling stages, a characteristic of considerable importance.

After dealing with the botanical characters of Virgilia, the author discusses the subject of its restricted range. Schonland considered it to be a relict; to this the author agrees, "if 'relict' implies that the species is an old but not an effete one." The study of the species has shown that it is a virile one, but owing to its poor means of dispersal, must have taken a considerable time to extend its limits. Dr. Phillips expresses the view that the species, being evolved within the south-western region, and dependent upon a medium hollard and the absence of frost, has been unable to invade areas surrounding that region. Poor means of dispersal, need of the seed to be stimulated before it will germinate, and dependence upon a particular strain of Pseudomonus radicicola are other factors to which he ascribes the restricted range.

Elsewhere in the same journal Dr. Phillips deals with the propagation of 'stinkwood' (Ocotea bullata E. Meyer) by vegetative means. So early as the seventies of last century Captain C. Harison, first Conservator of Forests of the Knysna-Humansdorp Forests, endeavoured to propagate this species by cuttings. The attempt was unsuccessful. In 1882 the Comte de Vasselo de Regne, Superintendent of Woods and Forests, considered that the stinkwood could reproduce itself like the poplar by cuttings, and recommended that experiments should be undertaken on the lines he recommended. These efforts were also unsuccessful, as were those of D. E. Hutchins, Conservator of Forests from 1888 until 1892. Other attempts carried out by forest officers from that date to 1922 proved abortive.

to 1922 proved abortive.

The experiments detailed in the present paper were commenced in the latter year, and so far as the work has gone to the present date, Dr. Phillips is forced to the conclusion that the propagation of the Ocotea

by vegetative means is not possible on a practical scale; but he invites criticism and suggestions from fellow-workers in this field of research. The continued experimentation under controlled conditions has shown that Ocotea bullata can be made to form callus and roots from cuttings, leaves, eyes, root-cuttings, and layers, but that the percentage of success obtained is insignificant. Furthermore, it is clear that establishment of the callussed and rooted portions is a matter of great difficulty. The principle reasons for the poor response of the plant are to be found in the delicate nature of the shoots and in the occurrence of the strongly lignified stereome and the U-shaped stone cells in the pericycle.

The practical value of the research work here undertaken will be obvious to the forest officer; for the effort to propagate the species has been until lately the subject of more or less rough experiments carried out for more than half a century

In a third paper published in the same journal, Dr Phillips gives a summary of pieliminary studies on the general biology of the flowers, figures, and young regeneration of sixty-three of the more important trees and shrubs occurring in the Knysna forest. This little handbook should prove of the greatest value to forest officers both from the botanical point of view and that of the sylvicultural. In support of the latter the following may be quoted:

"A point of the very greatest interest, but not at all easy to explain, is the truly excellent manner in which the yellow-wood (Podecarpus Thumbergii Hook) regenerates. . . . It might be suggested that the Knysna forests were in the past ages pure Podecarpus communities, and that these Gymnosperms are being slowly ousted by Phanerogamic trees; this supposition, however, is certainly not supported by the present efficient manner in which P. Thumbergii (and in places P elongata L'Herit, as well) regenerates. Perhaps the regeneration process, though still so excellent, has, with the centuries, gradually decreased in efficiency, and possibly the incoming hordes of flowering trees and shrubs are slowly but surely gaining the upper hand."

The author deals with the botanical characteristics of the sixty-three species on the usual lines. He then summarises the dispersal of the fruits and seeds under the headings of wind, water, birds, mammals, man, and 'various,' and discusses generally the question of dispersal—an important matter from the forestry point of view. In one of his tables Dr. Phillips summarises information relating to viability, chief agents of mortality, and average period required for germination of seeds. The author's results were based on "phenological studies of definitely marked trees over a period of about three and a half years, study of the structure of fruits and flowers, pollination experiments under natural and under controlled conditions, observations and experiments connected with the dispersal of fruits and seeds, and nursery

and quadrate germination experiments.

These papers place Dr. Phillips in the forefront amongst the younger generation of workers in this type of research work.

# University and Educational Intelligence.

Bristol.—The new Henry Herbert Wills Physics Laboratory, now practically completed, will be opened by Sir Ernest Rutherford on Oct 21. At the conclusion of the ceremony and inspection of the Laboratory, a Degree Congregation will be held at which the degree of Doctor of Science honoris causa will be conferred upon the following. Prof. Max Born (Gottingen), Sir William Bragg (Royal Institution, London), Prof. A. S. Eddington (Cambridge), Prot. Alfred Fowler (Imperial College of Science and Technology, London), Prof. P. Langevin (Paris), and Sir Ernest Rutherford (Cambridge)

DURHAM.—Mr. R B. Green, lecturer in anatomy at the College of Medicine, Newcastle-on-Tyne, for the past five years, and author of a "Manual of Human Anatomy for Dental Students," has been elected professor of anatomy in succession to Prof. R. Howden.

THE Department of the Interior, Bureau of Education, U.S.Ā, has issued a report (Bull, 1927, No. 14) on "Physical Education in American Colleges and Universities," by Marie M. Ready. The information has been collected from 182 institutions. Of these, 129 require a medical examination at entrance, 65 include physical efficiency tests as a part of it, and 79 keep continuous records of the students' physical condition during their entire college course. Corrective gymnastics are prescribed and required of those needing them by 70 per cent. of the institutions. Ability to pass certain tests in swimming is required by 48 institutions for graduation. A large number of institutions require a certain amount of physical education as a part of every undergraduate course leading to graduation; courses on hygiene are also required by many. Vaccination for small pox is made a definite requirement by 58, and for typhoid fever by 13 institutions.

THE Pan-Pacific Conference of Education, Rehabilitation, Reclamation, and Recreation, held at Honolulu last April, has a certain significance as a new grouping for purposes of international intellectual co-operation. The conference was called by the President of the United States and presided over by the U.S. Secretary of the Interior The other countries represented were Great Britam, Australia, Fiji Islands and British Western Pacific, New Zealand, France, Japan, Chile. Peru, Mexico, Colombia, and Nicaragua. The more important of the discussions were those on education, and these led up to a series of important resolutions, among which were the following: It is desirable to promote interchange of educational ideas and the establishment of educational centres of information through such means as visits of eminent professors, creation of university information bureaux. uniformity in educational terminology, and, as a step to that end, publication by the Bureau of Education, Washington, of a glossary of current educational terms, appointment of educational attachés to embassies and legations, and of a government Pan-Pacific committee on museum co-operation; vocational education of less than college grade should be included in the public school programme for the benefit of those who do not go to college; the extension of parental education by means of health centres, visiting nurses, correspondence courses, etc., should be encouraged, systematic co-ordination of the home with the school programme should be effected, and courses in maternal and child hygiene should be introduced so far as possible into the curriculum of secondary schools. A summary report of the proceedings appears in School Life (Bureau of Education, Washington) for June 1927.

# Calendar of Discovery and Invention.

September 25, 1845 – The first successful electric clock to be used in England was patented by Alexander Bain on Sept 25, 1845. The principle of this early clock is still used in electric clocks of the present time. The pendulum carried an electro-magnet which swing between two permanent magnets arranged with their N poles facing one another. The pendulum itself controlled the current which magnetised and demagnetised the electro-magnet in such a way that it was alternately attracted and repelled by the permanent magnets.

September 26, 1721—One of the earliest English patents for a pump was granted to John Orlebar on Sept 26, 1721. The inventor claimed "an entire new method of raising water by a much deeper, extensive and more expeditious way of sucking and foreing it than was ever yet or could be effected by the leaver and crank" The method, however, does not appear to have been sufficiently expeditious to have been much used.

September 27, 1825.—The commencement of the railway era may be said to date from the opening of the Stockton and Darlington Railway, which was the first public railway in the world on which steam locomotives were used. George Stevenson was the engineer. The line, with branches, was 36 miles long. It was a single track with passing places every quarter mile. The capital expenditure on the line was nearly £170,000. It was opened on Sept. 27, 1825.

September 28, 1852.—Henri Moissan, born on this date, was one of France's most illustrious scientists. A long series of researches on compounds of fluorine, began in 1884, led to the isolation, for the first time, of fluorine itself. Investigation of gaseous fluorides of carbon with the view of liberating the carbon in the form of diamond by removal of fluorine from the compounds failed. This failure led to the successful attempts to make artificial diamonds by the sudden cooling of molten iron containing carbon in solution. In order to obtain the necessary high temperatures, Moissan devised the electric furnace.

September 29, 1892.—On this date Lord Rayleigh addressed a letter to NATURE directing attention to his discovery that introgen prepared from air had a density greater by I part in 1000 than that prepared from ammonia Investigation by Rayleigh and Ramsay of the cause of the disagreement led to the discovery and isolation of the mert gas, argon. This was followed soon after by Ramsay's isolation of helium from the mineral elèveite

September 30, 1880.—The first astronomical photographs were made in 1840 by J. W. Draper, using daguerreotype plates. Draper's last great photographic achievement was a record of the great nebula in Orion, made on Sept 30, 1880. Attempts at improving on this first effort were cut short by Draper's death. On Jan. 30, 1883, however, Dr. A. Ainslie Common secured a picture far superior to any which had previously been taken.

October 1, 1840—William Henry Fox Talbot is best known as one of the founders of photography. He discovered 'photogenic drawing,' produced by the action of light through leaves, etc., in contact with silver chloride paper, fixation of the photographic image by potassium iodide or by washing in salt water, and evolved the method of printing positive images from transparent negatives on paper. He applied his genius in other spheres, and on Oct. 1, 1840, was granted a patent for an engine "for obtaining motive power" by electrical means. W. C.

#### cocieties and Academies.

#### PARIS.

was very of Sciences, Aug. 29 -The president most remove death of Emile Hang, membre titulaire of The small soft in of a system round a position of stable Paul Marchal Contribution to the d phenotypic study of the Trichograms uine The order of regularity of growth 7-2 ( 41 ) 7 1—Serge Bernstein A problem relating y monotone functions.—Y. Rocard 44. ( 1 ,1 . of the Einstein theory of diffusion of z Cathelin Formulæ of the curves of i electrical machines and of the induction core plates —P Lejay: The applications ar type of amplifier —Mlle Choucroun \* a 13\*3 Lim Las e permeability of membranes. The in-ie size of their interstices.—D Ivanoff. \* 10, 1 tion of the Grignard organo-magnesium An attempt to decide between the for-(Grignard) and R<sub>2</sub>Mg, MgX<sub>2</sub> (Jolibois) 116 8 g the product with anhydrous ether, in Wine nagnesium halide is more soluble 1 1,17 he action of carbon dioxide upon ethyl promide showed that magnesium bromide ed, and this is taken as proving the the symmetrical compound (Jolibois).— ... Remarks on the preceding paper. The 14 , D. Ivanoff are not quite conclusive, and 1 3641 though there may be a small proportion still thinks that the form RMgX pre-· form in equilibrium —Pierre Viennot · c of the neighbourhood of Sarrancolm énées)—N P. Péntcheff Researches on ses of some Bulgarian thermal springs. ne gases and the proportions of helium e given for the springs at Soulou-Dervent, No. 10, 4, and Hissar. The radioactivity of these spring the also been studied—F. d'Hérelle and E. Peur de tribution to the study of spontaneous Traffic # 75 .

# Royal Academy of the Lincei, May 15.—Giorgio

exetta. collations between solar eruptions and orac traction agnetic storms. Evidence is adduced in he view that the disturbed regions of the the end moms which, when their direction is such the sact the earth, result in perturbation of ter-testest in the learn —Q. Majorana A new method topical telephony by means of ordinary or ultra-tice in the control of the saction of the saction of the transfer of the saction of the saction of the saction of the transfer of telephony by means of ordinary or ultra-tice in the saction of the saction of the saction of ter-test of the saction of the saction of ter-test of the saction of terter of the saction of ter-test of the saction of the saction of ter-test of the saction of the saction of ter-test of the saction of the saction of the saction of ter-test of the saction of the saction of the saction of the saction of ter-test of the saction of the sact van at the mical observations, made by different \* Superfix , are in direct contradiction to Hantzsch's contradiction that the introgen atoms of hydrazoic acid sets acar year in ring formation.—L. Cambi and L. Stego: 🛰 ctrographic studies on complex iron : amde-1) The reaction between nitroprusside The results of spectrographic measureand ellerment of strate the existence of the equilibrium  $[Fe(CN)_5NO_2]''' + H_2O.$ B: itti Cebiceff's nets and conjugated emannian  $V_n$ .—M. Bossolasco: Systems 01 7 off's functions which are orthogonal.-G b Po 1: Investigations on the form of light an examination of shadow fringes .-11 35 1 - 1 15 11 : The transformations (m, n) which 11. 4 cha: +2 integrals of an equation with partial the second order in two independent deriva mtegrals of an analogous equation -

Mouskhelichvili: Periodic orbits and closed geodetic

Co-variant second differentials.—N.

lines -A Weil Functional linear calculus -G. Relativistic mechanics of holonomous systems -M Crudeli · A new category of stationary motions of (heavy) viscous liquids between vertical (round) cylindrical tubes.—U. Barbieri Geodetic connexion of the vertex of Andrate with the State network of the first order —E Fermi · The mechan-ism of emission in wave mechanics —G. Malquori · The system Fe(NO<sub>3</sub>)<sub>3</sub>: Al(NO<sub>3</sub>)<sub>3</sub> H<sub>2</sub>O at 25° Feric and aluminium intrates form neither additive compounds nor mixed crystals at 25°. The solid phases in equilibrium with the saturated solutions are  $Al(NO_3)_3$ ,  $9H_2O$  and  $Fe(NO_3)_3$ ,  $9H_2O$  respectively for the two branches of the solubility isotherm -G Natta and E. Casazza · Crystalline and atomic structure of ferrous hydroxide · The results of examination by the powder method and of the study of the photometric intensity show that ferrous hydroxide crystallises in the holohedral class of the rhombohedral system with a structure analogous to that of brucite The elementary cell, containing one molecule, has the dimensions a = 3 24, c = 4 47, c, a = 1 38 The calculated density is 3.40 and the structure appears to be ionic—M Comel Action of  $p{\rm H}$  on muscular pulp in the presence of phosphate ions

#### SYDNEY.

Royal Society of New South Wales, Aug 3-Sir George Knibbs. Rigorous analysis of the phenomena of multiple births. The number of cases of maternity and of the resulting numbers of twins, triplets, and quadruplets, are given for each year from 1890 to The frequency of twms changes very slowly with time, but increases linearly with age up to age 37 years, and then decreases linearly with age from 37 to 49 years. The probability of giving birth to twins through the division of an ovum after fertilisation, is sensibly a constant quantity throughout the productive period of female life; that is, it bears a constant ratio to the number of cases of maternity. The relative frequency of the production of twins from two ova, however, varies systematically with the age of the mother. The number of cases of triplets was not sufficiently large to admit of an exhaustive analysis, but the distribution shows that it is a function of the mother's age, the maximum frequency being at about age 35 years—W. L Waterhouse: Studies in the inheritance of resistance to leaf rust, *Puccinia anomala* Rostr, in crosses of barley (1) More than a hundred varieties of barley obtained from various countries and belonging to six species were tested to determine their reaction to an Australian physiological form of Puccinia anomala The majority of the varieties were quite susceptible, but all the resistant varieties had some characters which were agronomically undesirable. Cross-breeding work involving these resistant sorts and the commercially valuable susceptible types was undertaken. The  $F_1$  plants showed complete dominance of resistance. In the  $F_2$  there was segregation in the ratio of 3 resistant plants to 1 susceptible. The F<sub>3</sub> results confirm the hypothesis that a single dominant genetic factor underlies resistance. Evidence of linkage between rust resistance and morphological characters was lacking in the cases examined. There is an indication of correlation between resistance to Helminthosponium sativum and Puccinia anomala in certain of the varieties—M. B. Welch: The wood structure of some species of Kauri. Macroscopical and microscopical details, together with the principal uses and physical properties, are given six species of Kauri which find their way as ole mercial timbers to the Sydney market The hese tion in individual species renders identifies

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difficult. The plugs of phlobaphene material in the tracheids are described and the occurrence of wood parenchyma, usually regarded as being absent in the normal secondary wood of the Araucarmeæ, is noted.

# Official Publications Received.

Royal Society of Arts Report Designs, 1927. Pp. 30 (London) Journal of the Chemical Society Report on the Competition of Industrial

Journal of the Chemical Society containing Papers communicated to the Society August Pp vii+iv+1759-2022 (London Guiney and

Jackson)

i Department of Scientific and Industrial Research Summary of Progress of the Geological Survey of Great Bittain and the Museum of Practical Geology for 1920, with Report of the Geological Survey Board and Report of the Director Pp vii+202+0 plates (London H M Stationery Office) 48 67 net

Battersea Polytechnic, Battersea Paik Road, London, S W II.
Calendar of Evening and Afternoon Courses for Session 1927-1928 Pp. 24+10 plates Free Technical College for Day Students and Day School of Arts and Crafts, Calendar, Session 1927-1928 Pp. 47+11 plates 3d Department of Hygiene and Public Health, Session 1927-28

Pp. 28+3 plates. 3d Domestic Science Department and Tianning College, Full Time Day Instruction, Afternoon and Evening Classes, Session 1927-1928 Pp. 33+8 plates 3d (London)

Transactions of the Optical Society Vol. 28, 1920-27, No. 3 Pp. 11+117-172 108. Vol. 28, 1920-27, No. 4 Pp. 11+173-224. 108

(London)

Professional Schools, Post Graduation Courses and Specialist Studies in the Universities and University Colleges of Great Britain and Ireland Session 1927-8 Pp 40 (London Universities Bureau of the British

Empire)
Journal and Proceedings of the Asiatic Society of Bengal New Series, Vol 22, 1920, No 1 Pp 91+3 plates (Calcutta) 3 to 1upees
Journal of the Royal Society of Western Australia Vol 12, 1925-1926
Pp xx+239 (Perth) 35.
The East London College (University of London) Calendar, Session 1927-1928. Pp 184 (London) 1s
Aeronautical Research Committee Reports and Memoranda No. 1087
(Ac. 200) Wind Tunnel Tests on Aerofoil R A F 34 at Negative In culences By A S Hartshorn (A 3 a Aerofoils General, 17: — T 2417.)
Pp 4+2 plates 4d net No. 1090 (Ac. 259) Further Wind Tunnel Tests of a Slot and Aileron Control on a Wing of R A F 31 Section By A S Hartshorn (A 2 a. Stability Calculations and Model Experiments, 124—T 242b) Pp 9+9 plates 9d net (London II M Stationery Office) Office )

Office)

London University Guide and University Correspondence College Calendar, 1°27-1928 Pp 210 (Cambridge and London University Correspondence College) 28 tol.

Proceedings of the Royal Socrety of Edinburgh, Session 1926-1927 Vol. 47, Part 2, No. 14 On the Quantitative Relation of Comb Size and Gonadic Activity in the Foul. By A. W. Greenwood and F. A. E. Grew Pp. 190-197, 9d Vol. 47, Part 2, No. 15 The Life and Works of Nicolas Théodore de Saussure. By Dr. R. J. Harvey Gibson Pp. 198-201 tol. Vol. 47, Part 2, No. 16 The Stability of Suspensions on T. The Rate of Sedimentation of Kaolin Suspensions containing Colloidal Silicic Acid. By Dr. William Oglity Kermack and Dr. William Turner Horace Williamson Pp. 202-221 28 Vol. 47, Part 2, No. 17 A Case of partial Sey-Transformation in Cattle By A. Calder. Pp. 222-221+2 plates. 1s. 3d (Edinburgh). Robert Grant and Son , London Williams and Norgate, Ltd.)

Ltd)
University of Manchester. Faculty of Technology Prospectus of University Courses in the Municipal College of Technology, Session 1927-28. Pp 310. (Manchester.)
The Physical Society Proceedings, Vol 39, Part 5, August 15. Pp xix+375-472 (London Fleetway Press, Ltd.) 6. net
Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No. 32 A Survey of the Tanning Materials of Australia By D Cognil Pp. 136 (Melbourne: H J. Green)
Commonwealth of Australia Journal of the Council for Scientific and Industrial Research Vol 1, No 1, August Pp 63 (Melbourne: H J. Green) 15 6tl.

Commonwealth of Australia Journal of the Council for Scholland (Melbourne : H J. Green ) is 6d.

The East Anglian Institute of Agriculture (Essex Agricultural Committee) Calendar, 1927–1928 Pp. 84+xxviii (Chelmsford) Journal of the Royal Microscopical Society Series 3, Vol. 47, Part 3, September Pp. viv.+209 318 (London.) 100 net.

Department of the Interior Bureau of Education Bulletin, 1927, No. 6 Work of the Bureau of Education for the Natures of Alaska By Wilham Hamilton Pp. 5 cents Bulletin, 1926, No. 3 Biennia Survey of Education, 1922-1924 Pp. 111-886, 175 dollars (Washington, D C. Government Printing Office)

United States Department of Agriculture, Department Circular 419, Grouping of Soils on the Basis of Mechanical Analysis, By R. O. E. Davis and H. H. Bennett. Pp. 14 5 cents. Technical Bulletin No. 4 Lygus Elisus, a Pest of the Cotton Regions in Arizona and California By E. A. McGregor. Pp. 15 5 cents. (Washington, D. C. Government Printing Office)

Statens Meteorologisk-Hydrografiska Anstalt. Nr. 256 Organisation, eteorologique Internationale, Commission de Meteorologie agricolences-verbaux de la 28me Reunion, Zurich, 1926. Pp. 87, 2 ki. Nr. Description des stations meteorologiques Suedoises, piouvant aux Meteo-radiogrammes. Internationaux, publice confo. mement authorio 41 de la Conference des directeurs a Utriecht, 1928. Pp. 19, Meteorologiska nakttagelser i Sverige. Pp. 17, 7 kr. (Stockholin.) 10m Alsbok, 6, 1924 IV 7 kr (Stockholm)

Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt Band 4, No 1.\* Vogetationens utvecklingsgång i Norrland Av Knut Arnell Pp 28 2 kr Band 4, No 2 Statder over nederbordens fordelining vid olika vindar i Stva- och Gotaland (Distribution des pluses survant les vents dans les Provinces de Svealand et de Gotaland) Av C J Ostman Pp 30 2 kr (Stockholm) Bulletin geodesique Organe de la Section de Geodesie de l'Union Godesique et Geophysique Internationale Annee 1926, No 12, Octobre, novembre, decembre, 1926 Pp 187-265 Annee 1927, No 13, Janvier, fevrier, mars, 1927 Pp 64 (Foulouse Édouard Privat, Paris J Heimunn.)
Annales de l'Institut de Physique du Globe de l'Universite de Paris et

Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau central de Magnetisme terrestre Publices par les soins de Prof Ch Mauram Tome 5 Pp 1v+130 (Paris Les Presses universitaires de France)

stanes de France)
Smithsoman Institution Bureau of American Ethnology Bulletin 83 Burnals of the Algonquian, Siouan and Caddoan Tribes West of the Mississippi By David I Bushnell, Jr. Pp. v+103+37 plates (Washington, D.C. Government Printing Office) 50 cents.
Smithsoman Institution United States National Museum Bulletin 135 Handbook of the Collection of Musical Instituments in the United States National Museum By Frances Densinore Pp. in+164+9 plates (Washington, D.C. Government Printing Office.) 45 cents.
Proceedings of the American Philosophical Society held at Phila delphia for Promoting Useful Knowledge, Vol. 65, No. 5, Supplement Pp. 103+8 plates. (Philadelphia, Pa.)
School of Mines and Metalliugy, University of Missouri. Technical Series Bulletin, Vol. 9, No. 4, Descriptive Bibliography on Oil and Fluid Flow and Heat Transfer in Pipes. By Prof. Jos. B. Butler. Pp. 62 (Rolla, Mo.)

Fluid Flow and Heat Transfer in Pipes By Prof Joe B Butler Pp 62 (Rolla, Mo)
US Department of Agriculture Bureau of Biological Survey North American Fauna, No 50 Revision of the American Lemming Mice (Genus Synaptomys) By A Brazier Howell Pp n+38+2 plates (Washington, D C Government Printing Office) 10 cents
Publications of the Allegheny Observatory of the University of Pitts buigh Vol 6, No 8 Standard Solar Wave Lengths (5805 7112A) By Keivin Burns and C C Kress Pp 125-139 Vol 7, No 1 Photographic Photometry with the Thirty-inch Thaw Refractor The Light Curves of Twenty-nine Cepheid Variables By Frank C Jordan Pp 124 (Pittsburgh, Pa) 24 (Pittsburgh Pa) Publications du Laboratoire d'Astronomie et de Geodesie de l'Uni

Publications du Laborstoite d'Astronome et de Geodesie de l'Université de Louvain Vol 3 (No. 27 a 18), 1926 Pp. 290. (Louvain) R Osservatorio Astroforco de Catania Catalogo Astrofotografico Internazionale, 1960 O Zona di Catania fia le declinazioni + 16 e + 55° Vol. 1, Parte 1a Declinaz da +46° a +48°, ascons retta da 0h a 3h (Fascicolo N.1) Pp. v+8+40 Vol. 3, Parte 2ª Declinaz da +48° a +50°, ascens retta da 8h a 6h (Fascicolo N.18) Pp. viii+43. (Catania)

#### CATALOGUES.

X-Ray News and Chinical Photography No 2, August Pp 13-24. (London Kodak, Ltd.) Magnum Radio Products

Magnum Radio Products Publication No. 016927. Catalogue of complete Wireless Receiving Sets, Accessories and Components, Kits of Parts for Home Constructors. Pp. 36 (London Burne-Jones and Co . Ltd )

#### Diary of Societies.

SATURDAY, SIPILMBER 24

Institution of Municipal and County Engineers (South-Eastern District Meeting) (at Herne Bay), at 11 a m

#### WEDNESDAY, SEPTEMBER 28

FARADAY SOCILIY (at Chemical Society), at 8 — Prof. T. M. Lowly. The Electionic Theory of Valency. Part VI. The Molecular Structure of Strong and Weak Electrolytes. (b) Reversible Ionisation.—E. B. R. Prideaux. The Effect of Temperature on Diffusion Potentials.—C. Motton. The Ionisation of Polyhydrion Acids.—K. J. Pedersen. The Velocity of the Decomposition of Nitroacetic Acid in Aqueous Societies. Solution.

#### CONGRESSES.

SEPTEMBER 23-26

SEFTUMER 28-26

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at Trimity College, Cambridge) — Subjects for discussion. Report of the Public Libraries Committee of the Board of Education (A. E. Twentyman and Lieut-Col. L. Newcombe), Recent Developments in connexion with the Science Library, South Kensington (Su Henry Lyons), Information, Organisation, and Statistics in Industry (Major L. Ulwick, S. J. Nightingale, H. Quigley, W. Wallace, A. E. Overton, F. W. Tattersall), Patent Classification (A. R. Wright, A. Gomme), Problems of the Information Bureau (A. F. Ridley, P. K. Turner, D. J. C. Withers), Photographic Reproduction of Printed and MS Maternal (N. Parley, Su William Schooling, R. H. New), Standards (Book Selection in Science and Technology (Sir Richard Gregory).

#### SEPTEMBER 26 AND 27

CERAMIC SOCIETY (Refractory Materials Section Meeting) (at Town Hali, ERAMIC SOCITY (Refractory Materials Section Meeting) (at Town Hall)
Bounemouth), at 10 a M—A T Green A Consideration of Steel
Works Refractories,—W. J Rees and W. Hugill Note on Silica Bricky
made without Added Bond—R S Troop, Some Experiments in the
Drying of Clays—W C Hancock, Crushing Strength of United Fri
clay Bodies—A E. J Vickers, Determination of Iron Silicates.—
Prof D A Moulton Refractory Material used as "oriai for Laying
up Refractories—Dr. A F Joseph; Characterisal on of Clay—A, J.
Dale: Effects of Temperature on the Mechanical Properiors of Silica
Products Products.



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# The World Population Conference.

THE head of a social research department, such as exist on the other side of the Atlantic, who was on the outlook for a subject for a student's thesis, might do worse than suggest the modern phenomenon of conference holding as suitable for investigation Attendance at conferences and congresses threatens to consume an increasing proportion of the lifetime of scientific workers If the laborious method of investigation which finds favour in certain places was followed in the department, we may suppose that the student would classify the motives for organising conferences and the methods of procedure followed, and would finally attempt to correlate different procedures with the 'results' attained. Such a student might find it difficult to fit the recent World Population Conference at Geneva into any well-defined category. On one hand, the programme was limited to the strictly scientific discussion of certain aspects of the population problem On the other hand, it is probably correct to say that in the minds of most of those who attended was the conviction that the regulation of the quantity, quality, and distribution of population is a world problem which the organised communities of the world have to face at no distant It was a conference of biologists, statisticians, and economists, who did not trespass into the province of the politicians, but for the most part realised keenly the need for an agreed international policy if ordered progress is to be secured

The problem of migration was discussed at the conference, and it is in connexion with the difficulties arising from migration that the politician is first called upon to deal with practical population problems. It is only within the last few years, owing to the admirable work of the International Labour Office, that trustworthy and comprehensive statistics of migration have become available. These deserve careful analysis and discussion, which should be of practical use. But it may prove to be true that, once the forces leading to a desire for migration have been generated, it is beyond the skill of statesmen, however well informed and well intentioned they may be, to arrange a peaceful solution of the problem. It is necessary, therefore, to inquire into the nature of these forces in the hope that civilised nations may attempt to control them. Since migration is a most complex phenomenon, we are led to study the more fundamental aspects of the whole question, all of which bear upon migration. These

are such as the biological problems of fertility, the economic problems of optimum density, and the social problems of family limitation. The hope is that civilised nations will learn in time to found their internal policies upon such knowledge as may be accumulated upon these matters. In this way maladjustments may be avoided before their results coalesce and manifest themselves in the form of pressure to migrate. This they will only do if they realise that in the end national well-being coincides with international well-being

This programme sounds sufficiently chimerical, even though we have limited it to civilised States There can be little doubt, however, that a common action by civilised States is urgent. United upon a population policy, they may be able to maintain world order in face of developments in Asia which We now know, thanks to the seem inevitable recently published researches of economic historians, the true story of the great outpouring of population m the western world during the last century. It was due not to an increase in the birth-rate, but to a decrease in the death-rate In all likelihood events in the East will follow the same course Indeed, in India events are now taking this turn Since we cannot anticipate that any effective efforts will be made to guide events in the East so as to avoid the otherwise mevitable pressure towards migration, the only hope lies in a western world united in a common policy based upon a common basis of scientific investigation, and thus strong enough to control the situation If, on the other hand, the so-called civilised States embark upon competitions in numbers, they may well come to grief, quite apart from the fact that the eastern races will inevitably beat them at the game

It is a commonplace remark that the value of scientific conferences hes in the opportunities of personal contact, and not in the formal communications or discussions. It is only the readers of the popular press who imagine that great discoveries are announced at congresses. This is not quite as true of the social sciences as of the natural sciences. The mechanism for distributing the results of research work in the natural sciences seems to be in advance of that in the field of the social sciences. It was interesting to observe that when biological matters were under discussion, the results of recent research were more generally familiar than when social phenomena took the first place on the programme. Apart from the value of contact and of disseminating information on certain matters, the conference has achieved a distinct success in that it has decided to set up

the nucleus of a permanent organisation for the study of population problems. It cannot yet be said what form this will take. But if out of it grows an organisation of a truly international character, with the prestige of the full support of the representatives of the relevant sciences behind it, the conference will stand out as a notable event. The habit of international consultation on the scientific aspect will grow, and this cannot fail in time to influence international policy.

The function of a permanent international organisation might thus be twofold. The greater the prestige it gams, the more unlikely will it be that international policy will be directed regardless of the findings of biologists and economists would not be a propaganda organisation except in the sense that it would assist to disseminate facts. Again, a most useful piece of work lies in the correlation of investigations in different fields. The practical problems of population are complex problems. The biologist, the statistician, and the economist all have, for example, something to contribute towards the solution of the problem of migration A deliberate effort is, however, required in order to give due weight to the various contributions in such a fashion that practical policies have regard to all the more important factors involved It was evident enough at the conference that workers in different fields who have become interested in practical problems look at these problems only too often from a very narrow angle An international organisation might do good work in opening the eyes of specialists to the necessity of taking the results of workers in other fields into account before they deliver their opinions as experts upon problems which they have not fully envisaged

So far as it affects Great Britain, one aspect of the present situation, which is not without its importance, deserves a word of comment. It is not to be supposed that population problems when discussed at conferences or elsewhere will be referred to in the popular press unless they can be dressed up to justify a good headline or to form a sensational paragraph But it is disappointing to notice that the more responsible organs in Great Britain appear to be committed more of less to a boycott of these matters. The reference is not to this conference in particular so much a to events here during the last few years. We havt still a long way to travel towards a rational policil when editors of responsible papers regard popula tion problems as too indelicate or too dangerou. for discussion in their pages. A. M. C-S. s

# The Homologues of Carbon.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry By Dr J W Mellor Vol.
7 Ti, Zr, Hf, Th, Ge, Sn, Pb, Inert Gases Pp x+977. (London. Longmans, Green and Co, Ltd, 1927) 63s net.

THE writer of a 'comprehensive treatise' is in grave danger of being drowned by the torrent of information which flows in upon him as soon as he accepts the responsibility of taking cognisance of all the details of his chosen subject. It is almost a commonplace that the amount of readable matter in such a treatise (like the pressure of a gas) is inversely proportional to its volume On this basis of calculation, it might be expected that a treatise on chemistry which has only reached Group IV of the Periodic Classification in a seventh volume of 1000 pages would be intolerable in its dullness. It is therefore a welcome relief to find that the opening sentence of Dr. Mellor's new volume has the arresting character which one might expect to find at the beginning of a detective story "In 1791, W Gregor studied the black sands of Menacan, near Falmouth, Cornwall, and found some greyish-black granules which were attracted by a magnet" The sleuth then sets to work to solve his riddle with the help of hydrochloric and sulphuric acids, ammonia and potash-lye, and finally brings in tincture of galls as a means of checking a possible alibi, and ends by confiding —to Crell's Chemical Journal instead of to his friend Watson-his conclusion in the following terms:

"The extraordinary properties of the sand have led me to believe that it contains a new metallic substance. In order to distinguish this substance from others, I have ventured to suggest a name derived from the neighbourhood—Menacan, Cornwall—where it was found, and therefore I propose to call the metal menacanite."

If the narrative lacks the element of horror, which is such an asset to the writer of detective stories, it has at least the merit of taking us to the romantic west, to speculate whether the hero of the story saw the fig-tree growing out of the side of the shurch tower when he visited Menacan at the time of the French Revolution, whether he had a magnet is his pocket whilst he was reading in the church he message of Charles I. to his loyal Cornish subjects, and, finally, in what precise locality he discovered the magnetic granules. After reading in he succeeding sentences how the new element was obbed of its Cornish name and called 'titanium,' ne is impelled to breathe a lament, such as Urbain

must have uttered when 'celtium' was re-baptized as 'hafnium'

Since the volume deals with all the elements of Group IV, except carbon and silicon, the reader will turn with interest to Chap xliii. to see what the author has to say about the celtium-hafnium controversy, on which readers of Nature should be already well-informed (see vol 111, pp. 79, 182, 252, and 462) The verdict of our modern Berzelius is unequivocal—

"In 1911, G Urbain announced the discovery of a new element in some residues remaining after the separation of the lutecum-ytterbium fractions of the rare earths He called it celtium. Subsequent observations showed that all the evidence in favour of this element was worthless In May, 1922, A. Dauvillier found that the X-ray spectrum of these residues was in agreement with the presence of an element, atomic number 72, and G. Urbain applied the old term to the new element. The neo-celtium was not obtained in sufficient quantity, or sufficiently purified, to enable any other unequivocal statement to be made of its properties. Meanwhile, January 1923, D. Coster and G. von Hevesy reported a new element . . . The new element was called hafnium, Hf-from Hafnia, an ancient name for Copenhagen "

After reading these remarks it is not surprising to find that the chapter is labelled 'hafnium' and not 'celtium.'

The remaining elements of the first sub-group are zirconium and thorium, the latter being of interest both on account of its radioactivity and of its technical use in the 'incandescent gas-mantle.' These two topics form the subject of two sections in which the relevant researches are adequately reviewed.

Passing on to the other sub-group, we find a section on "The Physical Properties of Tm" which is effectively illustrated by photographs of slipbands in strained tin and of the surface of a sample of tin affected by the 'tin-pest.'

Under the heading "Physiological Action of Lead" an amazing story is told of a custom, which appears to have prevailed for many centuries, of "rendering harsh wine milder" by boiling it in lead vessels, or by the action of litharge. The htharge or white-lead was singularly efficacious in renovating spoilt wine, but its physiological effect was disastrous, producing, "according to the constitution of the consumer, a speedy or a lingering death, violent colors, obstructions, and other maladies." It was, however, so successful, from the point of view of the vendor, that its use could barely be stopped by the severest of punishments, torture and death. After this, it is difficult to

admit that the use of preservatives in tood is a purely modern vice, since it no longer seems necessary to suggest the infliction of penalties such as these merely in order to prevent the addition of boric acid (not exceeding 0.4 per cent.) to cream, or of benzoic acid to that form of coffee which is sold in a bottle instead of a tin

The final chapter of the volume deals with the "Inert Gases" This chapter relapses, perhaps inevitably, into the form of a catalogue of numerical data, alternating with long lists of authorities on a subject which has interested many workers both in physics and in chemistry. The reviewer has, however, formed the opinion that Dr. Mellor writes with more freedom and in a more interesting style as he 'warms up' to his colossal task; and the numerous illustrations, although generally reproduced on a very small scale, are of great value in setting out the precise conditions of equilibrium in scores of different systems. The photographs, which are not reduced so drastically, provide another welcome relief to the solidity of the text; and tiny diagrams, representing the results of Xray analysis of substances such as stannic iodide and the chlorostannates, show how closely the author has kept up with modern developments. He may therefore be congratulated without reserve on having arrived at his half-way house without showing any signs of weariness or flagging, since he appears to be even more fresh and vigorous now than when he first started out on his long journey. T. M. LOWRY.

# Zonæ Torridæ Tutamen.1

The Life and Work of Sir Patrick Manson. By Dr. Philip H. Manson-Bahr and Lieut.-Col. A Alcock. Pp. ix + 273 + 12 plates. (London, Toronto, Melbourne and Sydney: Cassell and Co., Ltd., 1927.) 16s. net.

In the ordinary progress of knowledge, men come and men go, each contributing according to the talents given to him, but from time to time there appears an individual whose work signals the beginning of a new era. Such a man does not merely add his own quota to the growing stream of knowledge, but seems, by some hidden power, to unlock the waters of the well of truth so that the stream becomes a flood. Such a man was Lister, whose centenary is celebrated this year, and such, too, was Manson, who stands in the same relation to modern tropical medicine as Lister does to modern surgery. It can but add to Lister's

<sup>1</sup> The motto of the Royal Society of Tropical Medicine and Hygiene, of which Manson was first president.

No. 3022, Vol. 1201

fame that the recently published "Life and Work of Sir Patrick Manson" makes known the part that Lister played in support of Manson and Ross in their pioneer work

Manson's contributions to scientific knowledge are as well known as they were varied A list of his published papers occupies twelve pages. He has been called 'Mosquito Manson.' It is true that his demonstration of the rôle of mosquitoes in relation to parasitic disease in man is the brightest single gem in his crown of achievement, but attention has been focussed too much on this one discovery. Much more than that underlay Blanchard's naming him "the father of the modern science of tropical medicine" It is fitting that the full measure of Manson's worth should be laid before the world by two men so intimately connected with him both in work and private life as Dr. Manson - Bahr and Col. Alcock. What impresses, in this record, is the bigness of the man. Here was no dry-as-dust scientist content with making additions to abstract knowledge. professional life he was a surgeon of skill and repute—and the two do not always go together-a physician of insight and mature judgment, an obstetrician whose ability and tact made him acceptable to a foreign and highly conservative race, a teacher who could attract and hold his pupils, a laboratory worker whose dexterity overcame the difficulties of place and circumstance: and his work in every sphere was illuminated by an inquiring genius which set him ever speculating, probing, searching, until basic facts and processes were laid bare. In the world of affairs he was shrewd and penetrating, with organising power and driving force which made him the effective adviser of a great department of State, and to which there remain as monuments the medical school of Hong Kong and the London School of Tropical Medicine. Of his private life too little is known, and even his biographers are compelled to sketch with uncertain pen the twenty years and more of Manson's life which were spent abroad. He was good company, kindly and courteous; tolerant of another's contrary opinion so long as it was sincerely held; a great reader, passionately fond of poetry; no mean geologist; a good man with a gun, and an angler after the heart of Isaac Walton.

Born in Aberdeenshire in 1844, Manson was a first destined to be an engineer. His youthful desire to learn 'how the wheels go round' is seen when we find him, as a schoolboy, dissecting a cather than the search and the search and the search are t

some physical frailty, turned his attention from the crude mechanisms of man's construction to the most delicate machine of all, man himself It may be, too, that the accident of the cat's containing a tapeworm determined his lifelong interest in the helminth parasites of man. Graduating in medicine at Aberdeen, he soon went abroad, settling first at Amoy and later in Hong Kong Some idea of the difficulties to be overcome may be gathered from his having had to run for his life when attempting to perform an autopsy, and from the fact that the Customs Gazette was for long his only medium of publication. His independence of character is seen in his repayment to his father, with the first-fruits of his labour, of the expenses of his medical education was liked and respected by the Chinese, and himself grew fond of them, a point brought out by Dr H M. Hanschell in an admirable pen portrait quoted by the authors. In Manson's experiences on his first return to England is found the key to his determined and successful efforts to establish definite teaching on the diseases peculiar to hot climates Impressed as he had been with his own ignorance of such subjects, he set about to acquire the fullest knowledge to be obtained in London. He found nothing save what he extracted for himself by searching the library of the British Museum.

Many pages of the "Life" are taken up by an extremely interesting series of letters from Manson to Ross, written while the latter was working to establish the mosquito-malarıa theory. This part of the book makes a vivid picture—as vivid as and truer than that painted in highly-coloured language by a recent writer in the New World . Ross in India labouring under difficulties, now making a little progress, now becoming sidetracked, now disheartened, now hopeful again as some success crowned his efforts; and Manson in London anxiously awaiting every mail, writing frequently with helpful suggestions, supporting in high places by all the influence he could wield or induce others to wield, encouraging to solve the problem before other investigators should succeed, and resterating, with a constancy which Ross might be pardoned for finding tiresome, his advice to "follow the flagellum" The outcome is known to all. Failing with the other mosquitoes, Ross succeeded with the dappled anopheles and was able to go a stage further than did Manson's hypothesis, and to show how the man-mosquitoman cycle is completed by the mosquito in the act of biting.

The account of Manson's work for the Chinese in Amoy and Hong Kong should be read by the many in China and the few m Great Britain who represent at present that the British in China have played no part save that of self-interest. Britain's history teems with the names of her sons who have gone to strange lands and have there enhanced the prestige of their race, and none more nobly than did Manson Though much of his life was spent outside the Empire and much in a colony territorially insignificant, yet he may with truth be called an Empire builder. Directly through his instrumentality, more than three thousand doctors have received expert training in those special arts and sciences without the exercise of which many of the British Empire's resources could never be tapped. His fame, like the influence of his life and work, is world-wide and abiding.

J. F. C. HASLAM.

# An Impeachment of Science.

Science: Leading and Misleading. By Arthur Lynch. Pp. 376 (London: John Murray, 1927.) 7s. 6d. net.

R. LYNCH covers a wide ground in his book on science dealing successively with mathematics, physics, chemistry, biology, physiology, medicine, psychology, and ethics. The modern sciences are so highly developed and specialised that it is unusual for a single writer to be able to discuss competently the technical details of more than a few sciences. Mr. Lynch considers that this tendency to specialisation requires correction, and with a laudable courage he attempts to put his principles into practice, mastering at the same time the technicalities of each science and explaining them in language which is intelligible to all. While, however, his book contains a great deal of scientific matter, its central theme does not appear to be so much the particular discoveries or the development of science as a criticism of current views as to the basic principles and methods of science. It is this philosophical theme which gives unity to what is otherwise a series of discursive essavs.

Mr. Lynch contends that the ordinary view or assumption as to the absolute certainty of scientific knowledge is mistaken, and he professes to establish his claim by recounting the constant mistakes committed by the great men of science of the past. The soundness of such an argument may be open to question, but the historical account given of science is often lively and interesting, although

perhaps too much is made of the small mistakes and foibles of great men When Mr. Lynch comes to philosophers such as Kant, he paints a picture which is clearly too one-sided to carry much conviction. He does not set out in this book to explain at any length his own theory as to the character of scientific certainty, but he is content to indicate a view somewhat similar to that of Mach and to refer the reader to his work on psychology for a more complete exposition.

In his first essay Mr. Lynch reviews briefly the early period when the philosophers were also the leading scientific workers. Actuated by a praiseworthy desire to make the speculations of these early thinkers live, he tends to modernise overmuch their doctrines; thus he says that in Heraclitus we find the early apprehension of the principle of evolution and also the theory of ether; moreover, he scarcely does justice to the metaphysics either of Plato or of Aristotle. According to Mr. Lynch, the subject which Plato pursued with the greatest tenacity was mathematics, but the medieval schoolmen seized upon the more obscure of Plato's doctrines and "left their malign influence to obfuscate the brains of many of our most famous and authoritative thinkers of to-day"; and while Aristotle's "Ethics" is "a work of marvellous creation," Aristotle was nevertheless not strong in the "field of psychological analysis."

If Mr. Lynch takes a 'rationalist' view of medieval Platonism and is also hostile to modern absolute idealism, he is equally sceptical both of the scientific and of the philosophical theories of relativism. If his chapters on relativity have been understood aright, he thinks that Einstein has added very little to the body of scientific knowledge, and that his theory is rather a convenient formula liable to be overturned to-morrow, than a statement of an abiding truth. Philosophical relativists, such as Lord Haldane, Mr. Lynch states have taken Polonius as their model and cannot be regarded seriously. Apparently the cure for all these fallacies and the basis for a true system of science and philosophy is to be found in a new constructive psychology.

In the latter part of his book Mr. Lynch reviews modern schools of thought, and he does not conceal his contempt for most of the leading thinkers. Bradley, Bergson, Bosanquet, the Earl of Balfour, Dean Inge, Dr. Schiller, Prof. Wildon Carr, Prof. Dawes Hicks, and others, are dismissed with none too complimentary remarks, and for universities and scientific associations generally Mr. Lynch has scarcely a good word to say. He appeals

over the heads of the professors to the great public, but he should bear in mind that while the public always likes and admires outspoken criticism, witty or caustic as the case may be, it immediately turns a deaf ear if it suspects a personal grudge or ill temper

# The Increase of Epidemic Diseases of the Nervous System.

Epidemic Diseases of the Central Nervous System. By Dr. Arthur Salusbury MacNalty. Pp. xiii + 194. (London. Faber and Gwyer, Ltd. (The Scientific Press), 1927) 12s. 6d. net.

LIFE and its incidents are always changing, new fashions and phenomena come and go and fashions and phenomena come and go, and among these our diseases alter not only in name but also in nature. With the more rapid means of communication the rate of living, though not longevity, has increased, and, like most generations, the present complacently condoles with itself on the increased strain of modern life. Neurology has made enormous advances in recent years, and, as a result, many new diseases have become recognised, but apart from the influence of this addition to knowledge there appears to be an increasing susceptibility of the central nervous system to attacks of epidemic disease, such as acute poliomyehtis during this century, during the special conditions of the War cerebrospmal fever, and since the later years of the War a practically new disease, epidemic or lethargic encephalitis, known in the lay press as 'sleepy sickness,' which should be distinguished from the sleeping sickness of more tropical climates, due to infection with trypano-

The endowed lectures at medical institutions offer an opportunity for the publication of original investigations and for surveys of current knowledge. The appearance in an expanded form, with more recent additions, of the scholarly Milroy Lectures on "Epidemic Diseases of the Central Nervous System," given in 1925 before the Royal College of Physicians of London by Dr. A. Salusbury MacNalty, of the Ministry of Health, and dedicated to his former teacher, the president of the College, Sir John Rose Bradford, provides convincing proof of the value of such endowments. Dr. MacNalty had much to do with the early investigation of encephalitis lethargica, first described early in 1917 by Economo and von Wiesner in Vienna, and attracting attention a year later in England, where it was first suggested to be botulism, a very rare disease in Great Britain, of which the only definite

outbreak occurred in 1922 at Loch Maree from eating infected potted duck paste.

Well equipped in epidemiology, Dr MacNalty is therefore able to give an admirable account of the epidemic nature and history of the three diseasesacute poliomvelitis and polioencephalitis, cerebrospinal fever, and encephalitis lethargica—not only in man but also of what is known about their occurrence in animals Since the end of the War the incidence of cerebrospinal fever has greatly diminished, but unfortunately the reverse applies to the other two, both of which are due to infection with an ultra-microscopic virus spread by healthy 'carriers' The after-effects of encephalitis lethargica on the brain, which may follow acute attacks so slight as to pass almost or quite unnoticed, are calamitous; when the incidence of abortive attacks and of its form, or the closely allied condition, known as epidemic hiccup, which do not appear in the notification returns, are taken into account, the increase becomes positively alarming. A thorough knowledge of the causation and epidemiology of these diseases is most important in providing efficient means for their prevention, a subject on which Dr. MacNalty also touches, and hence this well-written and detailed account of their epidemiology is most appropriate. H. R.

### Our Bookshelf.

Lehrbuch der Geophysik. Herausgegeben von Dr. B. Gutenberg. Lieferung 3. Pp. 401-608. (Berlin: Gebrüder Borntraeger, 1926.) 12 gold marks.

The third instalment of the work edited by Prof. Gutenberg maintains the standard of the first two. It begins with a clear and up-to-date account of terrestrial magnetism by Dr J. Bartels. One learns in it that the whole energy of the earth's permanent magnetic field is equivalent to that of the radiation received from the sun in three seconds!—or, it may be remarked, to the gravitational energy released by a radial contraction of the order of  $10^{-6}$  cm. Prof. Gutenberg then devotes sixty-six pages to the physical constitution, figure, density, and thermal state of the earth. In a useful, if brief, account of the figure of the earth, the Radau approximation is given, but neither Darwin nor Callandreau is mentioned.

Present knowledge of the distribution of density is well summarized. The three physical states of matter are clearly defined on p. 455. The distinguishing mark of a gas is its high compressibility, while a solid is distinguished from a liquid by the possession of a measurable rigidity, or elasticity of form, which liquids have not. Glasses are therefore regarded as solids, and not as liquids. But Gutenberg seems to contemplate seriously the possibility that all solids have a finite viscosity; the proposi-

tion is perhaps worth consideration, though neither experiment nor theory lends it much support. The work of Bridgman, Tammann, and others on the properties of matter at high temperatures and pressures is described. Methods of measuring gravity and its variations with position are treated fully by Prof Ansel, with special reference to the detection of masses of abnormal density near the surface. An account of electric currents in the crust is then given by Bartels.

The last chapter, by Gutenberg, deals with the application of seismological methods to the investigation of the uppermost layers of the crust. Until recently seismology, so far as it has dealt with the sedimentary layer at all, has usually regarded it mainly as a nuisance But the problems it involves are now being attacked, and this chapter is, I believe, the first connected account of the results. Artificial shocks, such as explosions or even the fall of a heavy body, are recorded on instruments with magnifications of the order of amillion, so that movements of almost molecular extent can be detected. The sound wave in the air is a prominent feature of the records. The velocities of compressional waves in the sedimentary rocks are notably less than in igneous ones, of the order of 2 km /sec. as against 5.4 km to 8 km./sec. Distortional waves have hitherto been found more difficult to observe.

H. J.

Mind and its Disorders. a Textbook for Students and Practitioners of Medicine. By Dr. W. H. B. Stoddart. (Lewis's Practical Series.) Fifth edition. Pp. xx+593+12 plates. (London: H. K. Lewis and Co., Ltd., 1926.) 21s. net.

In the fifth edition of his well-known text-book, Dr. Stoddart has made several changes to conform with the latest ideas on the ever-growing subject of psychiatry. It is perhaps in general paralysis that there has been during the last few years the most prominent advance in therapeutics of mental disease. The section on the treatment of this disorder contains details of the modern treatment by induced malaria, and also refers to the use of tryparsamide. The main new feature of clinical psychiatry is the recognition of mental changes following epidemic encephalitis, and a chapter is devoted to this disease and its sequelæ. Dr. Stoddart's experience is that certification is rarely required, and then only for the confused type of post-encephalitic state, but cases certainly occur in which that step is necessitated by changes in the moral sphere.

The author continues to deal with psychopathology on dogmatic Freudian lines. The root of the manic-depressive psychosis is regarded as a repressed sado-masochism; the former intraneuronic intoxication theory is quite abandoned. Paranoia is said to have an invariable foundation of repressed homosexuality. Exophthalmic goitre is considered to be a variety of anxiety hysteria. It is left undecided whether dementia præcox is primarily organic or psychogenic. While these views may not find general acceptance, they form excellent illustrations of the psycho-analytical

method, which, however far it may be removed from his own ideas, must receive the consideration of every psychiatrist

Principles of Human Geography. By P Vidal de la Blache Edited by Emmanuel de Martonne Authorised translation from the French by Dr Millicent Todd Bingham Pp xv+511+6 plates (London Constable and Co, Ltd, 1926) 18s net

HUMAN geography is a new subject, but its facts It is the outcome of the growth of ideas rather than the result of discovery Man is not an abstraction in the world in which he lives, but his evolution is related to the environment in which The study of environment is not static but one that involves continual change in values as man evolves Prof Vidal de la Blache shows that there is more in geography than merely a study of the stage on which man has played his part, for man himself is a geographical factor changing and moulding his environment, and the study of progress entails a study of his struggles with physical and other obstacles. His distribution over the globe and his varying degrees of progress are the expression of the geographical conditions he has met.

The book is incomplete except for the early chapters on the distribution of population, and it has been put together from the author's notes after his death. Some of the more interesting sections on the factors of civilisation and the growth and influence of transport are fragmentary, but long enough to show the author's trend of thought Fortunately, some important maps were complete and are included. In spite of its imperfections, the book is an important contribution to a side of geography which is specially associated with French workers.

Körper und Keimzellen. Von Prof Jürgen W. Harms. (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 9.) Teil 1. Pp. x+516. 33 gold marks. Teil 2. Pp. iii +517-1023. 33 gold marks. (Berlin Julius Springer, 1926.)

The author, holding that a proper understanding of the relation of germplasm to soma is a prerequisite in the investigation of all problems of biology, has set himself the task of giving in broad review an account of the established facts concerning this relationship as it exists in the animal kingdom (including man) The result of his endeavour is this excellent and most useful book. The objective method of presentation, the historical review followed by a fair statement of modern opinion, the judicial comparison of opposing doctrines, the avoidance of any exhibition of preference save only in those matters upon which the author is a recognised authority, make the reading of this book both pleasant and profitable.

The subject of the endocrine activity of the gonads is treated in a most thorough manner, and any one who seeks trustworthy guidance in the Stemach-Stieve controversy will find it here. Castration,

gonad implantation, substitution therapy, and rejuvenation are discussed fully, and the rôle of the nervous system in the maintenance of the sexual characters is examined by reference to the author's well-known work concerning the thumbpad of the frog. The bibliography does not include all the names and papers to which reference is made in the text.

This work, into which Harms's earlier book is worked in ("Die innere Sekretion der Keimdrusen," Jena, 1914), can be warmly recommended. Not the least of its good qualities is that the author indicates everywhere lines of profitable research.

Indicators their Use in Quantitative Analysis and in the Colorimetric Determination of Hydrogen-Ion Concentration. By Dr I. M. Kolthoff An authorised translation based upon the second German edition, revised and enlarged, by Dr. N Howell Furman Pp. xii +269. (New York: John Wiley and Sons, Inc., London Chapman and Hall, Ltd., 1926) 17s. 6d. net

Until the development of the conception of hydrogen-ion concentration, the use of indicators was confined within more or less empirical boundaries. It is therefore only during comparatively recent years that any appreciable insight has been obtained of the principles underlying the reactions of these bodies

The volume under notice fully realises the avowed intention of its author to present a treatise the practical nature of which should be developed from theoretical considerations, without being overwhelmed by them. In the early chapters dealing with neutralisations generally, with amphotoric compounds and with the colour change of indicators experimental examples are described, wherever possible, to illustrate the various points as they The uses of indicators in quantitative neutralisations and in the colorimetric determination of hydrogen-ion concentration, with practical applications, are then discussed Short chapters deal with indicator papers and with the theories of the colour changes of indicators, as distinct from the causes which bring about such changes.

Apart from an occasional loose phrase, the translation is well done; misprints are but few. Some useful tables and indexes conclude a volume which merits careful study by those who desire to obtain fullest benefit from the intelligent use of indicators.

B. A. E.

Atoms and Molecules being Part I and Chapter xii. of "The Foundations of Chemical Theory." By Prof. R. M Caven Pp. viii + 141. (London and Glasgow: Blackie and Son, Ltd., 1927) 7s net.

THE chapters which have been retained in this abbreviation deal with atomic and molecular theories, atomic and molecular weights, valency and chemical constitution, classification of the elements, the modern view of the atom and the molecule, and finally the colloidal state. The chapters omitted have reference chiefly to the states of matter, the properties of solutions and the various types of chemical change.

# Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

#### The Origin of the Nebulium Spectrum.

In the spectra of the gaseous nebulæ several very strong lines are found which have not been duplicated in any terrestrial source. Many lines of evidence point to the fact that the lines are emitted by an element of low atomic weight. Since the spectra of the light elements, as excited in terrestrial sources, are well known, this leads to the conclusion that there must be some condition, presumably low density, which exists in the nebulæ, that causes additional lines to be emitted.

A type of line, which one would expect to be affected by density in this manner, is that caused by a jump from a metastable state to a lower level. Such a metastable state is usually considered to be one from which jumps are very improbable, that is, one of which the average life is very long. Consequently, under terrestrial conditions, where the time between impacts is a very small fraction of a second, the metastable atom, in general, will be dropped down to a lower state by collisions of the second kind or by impact with the walls long before the return would take place spontaneously with the emission of radiation. Under conditions in the nebulæ, however, the time between impacts is very long, and many of these atoms will have a chance to return to lower states with the emission of radiation corresponding to the difference in energy between these metastable states.

Since the nebulæ are known to emit the well-known spectra of highly ionised nitrogen and oxygen, these ions at once suggest themselves as possible sources of the unknown lines as well.

In a four-electron system such as  $N_{\rm II}$  and  $O_{\rm III}$  the lowest energy levels are due to the configuration of 2 (2s) and 2 (2p) electrons. According to the Hund theory, this configuration gives rise to  $^3P$ ,  $^1D$ , and  $^1S$  terms. All but the lowest of these are metastable, since any jump between them involves a zero change in the azimuthal quantum number. In a five-electron system such as  $O_{\rm II}$ , the normal configuration of 2 (2s) and 3 (2p) electrons forms  $^4S$ ,  $^2D$ , and  $^2P$  terms. These are likewise metastable.

The frequency of lines due to jumps between these terms can be calculated accurately in only two cases, namely,  $^1D^{-1}S$  of  $O_{\rm III}$  and  $^2D^{-2}P$  of  $O_{\rm II}$ . The calculated frequencies, if unresolved, are 22916 and 13646,which correspond to wave-lengths of 4362 54 Å.U. and 7326 2 Å U. respectively. Two of the strongest nebulium lines are found at 4363 21 Å.U. and 7325 Å.U. These deviations are well within the rather large experimental errors arising from the fact that the values are calculated from the difference in frequency of lines in the 500 Å.U. region.

Another group of which the position can be predicted roughly is  ${}^4S^{-2}D$  of  $O_{II}$ . Both terms have been calculated from series relationships, but as no intercombinations between quartets and doublets have been found, the predicted frequency is only approximate. The predicted frequencies of the two components are 27157 and 27175, which correspond to wave-lengths of 3681·25 Å.U. and 3678 81 Å.U respectively. The strongest two nebulum lines in the ultra-violet are at 3728 91 Å.U. and 3726·16 Å.U. The doublet separation checks well and uncertainties

in the adjustment of series limits for either the quartets or the doublets can account for the deviation in wave-lengths

The strongest lines in the whole nebulium spectrum are the pair at 5006 84 Å U. and 4958.91 Å U. These have a separation of 193 frequency units, which is in almost exact agreement with the separation of 192 units observed for  $^3P_1$ - $^3P_2$  in  $O_{\rm III}$ . This at once suggests that these two lines are  $^3P_2$ - $^1D_2$  and  $^3P_1$ - $^1D_2$  respectively. The relative intensity of these two lines is just what would be expected.

Another strong pair occurs at 6583 6 Å.U. and 6548 l Å.U., showing a separation of 82 3 frequency units. This agrees very well with the known separation of 82 7 for  ${}^3P_1 {}^{-3}P_2$  in  $N_{\rm II}$ . It these lines are identified as  ${}^3P_2 {}^{-1}D_2$  and  ${}^3P_1 {}^{-1}D_2$  of  $N_{\rm II}$ . one can calculate at once the term value of  ${}^1D_2$ , since those of  ${}^3P$  are already known. This  ${}^1D$  term should combine strongly with the  ${}^1P$  term of the  ${}^3P$   ${}^3$  configuration and the  ${}^1D$  term of the  ${}^3P$   ${}^3$  configuration. The term values of these singlet terms have already been determined accurately by Fowler. The calculated positions of the lines arising from these combinations, obtained with the use of the above nebulium lines, are 746 98 Å U. and 582 15 Å U. Strong lines are observed in the nitrogen spectrum at 746 97 Å U. and 582 16 Å U. This furnishes almost certain proof of the identification of this pair of nebulium lines.

identification of this pair of nebulium lines. The other lines to be expected, on the above hypothesis, from  $N_{\rm II}$ ,  $N_{\rm III}$ ,  $O_{\rm II}$ , and  $O_{\rm III}$ , fall outside the range of wave-lengths easily observable in nebulæ. The above identifications account for all but two or three of the strong nebulium lines. It should be noted that in every case where it has been possible to make an exact prediction, a strong nebulium line has been observed at the calculated place. Furthermore, the above identifications are entirely in accord with the behaviour of these lines in the nebulæ as observed by Wright.

The nebulium lines thus far identified are collected in Table I.

	TABLE	I.
λ	Source.	Series Designation.
7325.0	$O_{II}$	$^2D$ - $^2P$
$6583\ 6$	$N_{II}$	${}^{3}P_{2}$ - ${}^{1}D$
$6548 \cdot 1$	$N_{II}$	${}^{3}P_{1}$ - ${}^{1}D$
5006.84	$O_{III}$	${}^{3}P_{2}$ $\cdot {}^{1}D$
4958 91	$O_{III}$	${}^{3}P_{1}^{-1}D$
$4363 \cdot 21$	$O_{III}$	$^1D^1$ - $^1S$
372891	$O_{II}$	$^4S$ - $^2D_3$
$3726 \cdot 16$	$O_{II}$	${}^{4}S - {}^{2}D_{2}$

I. S. Bowen.

Norman Bridge Laboratory of Physics, California Institute of Technology, Sept. 7.

### The Function of Water Vapour in the Photosynthesis of Hydrogen Chloride.

EVIDENCE was presented (B. Lewis and E. K. Rideal, J. Chem. Soc., 129, 583 and 596; 1926) for the view that the photo-expansion of bromine and other halogens in the presence of water vapour (Budde effect) is due to heat liberated by the recombination of halogen atoms set free by the absorption of light quanta. Although absorption of radiation occurs in the dry gas, no Budde effect is observable (J. W. Mellor, J. Chem. Soc., 81, 1280; 1902; Lewis and Rideal, loc. cit.) even when the gas is subjected to an intense source of ultra-violet radiation (E. B. Ludlam, Proc. Roy. Soc. Edinburgh, 44, 197, 1924). This is interpreted to mean that the halogen does not dissociate in the dry state; that the radiation absorbed

activates the halogen molecule for a short period of time and is then emitted (presumably as longer wave-

It has been shown by several workers that the photo-chemical union of hydrogen and chlorine does not proceed in visible radiation in the absence of water vapour. Of the numerous mechanisms proposed for this reaction, the Nernst atomic chain still remains on the whole the most plausible. The formation of hydrogen bromide from the elements is known to proceed by way of bromine atoms, the endothermicity of one of the atomic steps preventing long chains (for literature see Lewis and Rideal, J. Amer. Chem. Soc. 48, 2553, 1926) Lewis and Rideal (J. Amer. Chem. Soc, loc. cit) have shown that the absence of water vapour retards this reaction of space prevents adequate reply to Bodenstem and Jost (J. Amer Chem Soc, 49, 1416; 1927), but it should be mentioned that Table III., p 2558 of Lewis and Rideal's paper, presents a series of experiments on the formation of hydrogen bromide in as dry a system as was possible at the high temperatures without the use of phosphorus pentoxide, in which considerable retardation was observed, and in one case, nearly stopped completely. Two or three typographical errors prevail; the values for experiments 8 and 11 should read 45.8 per cent. and 56 per cent., and in the last column 52 2 per cent. belongs to experiment 10

It is generally agreed that the high quantum yield in the photo-synthesis of hydrogen chloride is due to some chain mechanism involving chloride atoms. Since the mechanism of the Budde effect is probably the primary step in this reaction (Bernard Lewis, Trans. Far. Soc., 21, 585; 1926), and if the atoms which initiate the chains are absent, then it follows that the latter cannot be initiated in the absence of water vapour. There seems to be no evidence that water vapour functions in the chain itself as was proposed by Coehn and Jung (Ber. 56, 696; 1923) and Coehn and Heymer (Die Naturwissenschaften, 14, 299; 1926) from the observation that the dry gases did not combine in the visible but did so in the ultraviolet. For the purpose of brief discussion these two

mechanisms will be reproduced here.

A. Moist hydrogen and chlorine: in visible light.

(1)  $\text{Cl}_2 + \text{h}_{\nu}$  (small) =  $\text{Cl'}_2$ (2)  $\text{Cl'}_2 + \text{Cl}_2$  =  $\text{Cl}_2 +$ (3)  $\text{Cl} + \text{H}_2 \tilde{\text{O}}$  = HCl $= \frac{\text{Cl}_2}{2} + 2 \text{ Cl}$ = HCl + OH(4) OH + H<sub>2</sub>  $= H_0O + H$ (5) H + Cl<sub>2</sub> = HCl + Cl

B. Dry hydrogen and chlorine: in ultra-violet.

 $\begin{array}{cccc} \text{(1) Cl}_2 + \text{h}_{\text{I}} \text{ (large)} &= \text{Cl}''_2 \\ \text{(2) Cl}''_2 + \text{Cl}_2 &= \text{Cl}_2 + 2 \text{ Cl} \\ \text{(3) Cl}''_2 + \text{H}_2 &= \text{Cl}_2 + 2 \text{ H} \\ \text{twice (4) H} + \text{Cl}_2 &= \text{HCl} + \text{Cl} \\ \text{(5) Cl} + \text{Cl} &= \text{Cl}_2 \end{array}$ 

Reaction (2) in both mechanisms is unnecessary, since we know that non-polar (Franck, Trans. Far. Soc., 21, 536; 1926) and polar (Kondratjew, Z. f. Physik, 39, 191; 1926; Bernard Lewis, NATURE, 119, 493; 1927) molecules undergo optical dissociation in a single act without collision. It has been pointed out that the time between absorption and dissociation for these simple molecules must be shorter than 10-10 sec. (Bernard Lewis, Proc. Nat. Acad. Sci., in press). If atoms can be formed in the dry gas, then since (1) and (2) in B are confined to one step without collision, the dissociation of the halogen would have occurred before (3) could take place. lower hydrogen pressures the quantum yield would be less than one. If we agree that (2) does take place in the dry gas, then in a 1:1 mixture of hydrogen and

chlorine (2) may occur more often than (3), due to the smaller heat of dissociation, and the quantum yield would again be less than one Altering the relative concentrations would also affect the yield It is difficult to see why chlorine atoms resulting from (2) and (4) in B cannot propagate chains as in

### $Cl + H_2 = HCl + H$ ,

for this reaction still remains thermodynamically possible from latest thermochemical data In this case chains, and therefore high quantum yields, would be expected Mechanism B, for the dry gases, cannot explain satisfactorily the theoretically predicted quantum yield of two which was in general realised by Coehn and Heymer

The chain mechanism in A for the moist gases is extremely doubtful Considerable doubt has been cast on (3) by Norrish (Trans. Far Soc, 21, 575, 1926). Thon (Fortschritt d chem Phys, 18, 60-67, 1926), after certain considerations, concludes with Lewis and Rideal (J. Am Chem Soc, loc cit.) that the action of water is physical and therefore does not

enter into the chain mechanism

It can be shown approximately that reaction (4) in A is endothermic to such an extent that the small efficiency of fruitful collisions between OH and H2 would cut the chains very short. Thus an essential step in the chain is not always effective, if indeed it is at all, and the mechanism therefore is inadmissible.

Until evidence to the contrary is available, the mechanism of the moist reaction must be considered as a primary dissociation of the halogen under the influence of water vapour followed by an atomic chain, either that of Nernst or one suggested by Thon (Z. phys. Chem., 124, 327; 1926). The dry reaction is most simply explained by activation of a chlorine molecule and its interaction with hydrogen molecules to form two molecules of hydrogen chloride. However, Thon (loc. cit., p. 69) suggests that a trace of oxygen in Coehn and Heymer's experiments would bring about the photo-synthesis of water in ultra-violet light and the main reaction could proceed. This could be tested by exposing a dry mixture to visible light after the reaction had just commenced by exposure to ultra-violet If this reasoning is correct. the mixture should now react in the visible.

There is a possible method of testing directly whether water vapour functions in the chain mechanism. Porter, Bardwell, and Lind (J. Am.)Chem. Soc., 48, 2603, 1926), m some important experiments on the synthesis of hydrogen chloride, have shown that the chains are of the same length whether the reaction is carried out photochemically or by means of alpha radiation Since the variation of sensitivity of the mixture produces the same change in rate of both reactions, they conclude that "this must mean that the reaction chains in both cases are of equal length, and hence the mechanisms of the secondary reactions are identical whatever they may Ionisation by alpha radiation always takes place, and thus the initiators of the chains are present regardless of water vapour. If water plays a rôle in the chain mechanism, no chains should be propagated when a dry mixture of hydrogen and chlorine is exposed to alpha radiation. On the other hand, if chains, and therefore high quantum yields, persist in the absence of water vapour, this would indicate that the latter does not function in the reaction chains. It is intended to carry out these experiments.

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#### Transmutation of Elements.

SINCE the publication of my letter on the transmutation of lead in Nature of May I, 1926, I have continued the experiments in collaboration with Dr. A. Karssen and W. A. Frederikse. In the letter mentioned above I stated that our repeated experiments showed that the phenomena observed with the quartz-lead lamp and pointing to a transmutation of lead into mercury, were very difficult to reproduce. The lamp with which we obtained the photograms published was the tenth made after changing the construction from time to time to secure the most distinct results. In the hope of arriving at a still better method, and intending to distil off the mercury continually during the sparking process, the construction of the lamp was again changed. The result, however, was that, even without distillation, the lead spectrum now remained absolutely free from mercury lines.

After this very unexpected result, a lamp was constructed as nearly identical as possible with the lamp before the last modification was made. The behaviour of this new lamp was not quite the same as that of the old one; the discharges were different, the last contact was not made by a very thin jet of lead, and by oscillation all the gas was pumped out of the sparking space, which did not take place with the old lamp. Notwithstanding this, the appearance of mer-cury lines was again observed, but not so strong, and after much longer periods than before. From this we obtained the impression that the kind of discharge, being influenced by the construction of the lamp, was important here. To find another easily reproducible method, we tried now another construction which allowed sparking at high voltages, 160,000 volts and 10 milliamperes in a nitrogen atmosphere at different pressures between two solid lead electrodes, but the lead spectrum remained absolutely free from mercury lines.

Experiments of the same kind were carried out with a lamp in which the lead electrodes were heated above the melting point, but the results of all these experiments with long sparks and consequently with discharges of relatively small potential fall, gave only

negative results

In the meantime, as mentioned in another paper, we applied a different sparking method, using carbon disulphide as liquid dielectric. From the extra pure lead supplied by Kahlbaum, and treated by us in the way already described to remove every trace of mercury, two electrodes, 15 mm. thick and 2 cm. long, were made. These were mounted in two holders of steel, connected to two rods of steel, and all the steel parts were heated beforehand for twenty-four hours in an electric furnace at about 800° in an atmosphere of pure nitrogen. The steel-holders and rods treated in this way, and also the lead electrodes, were examined by the slightly altered method of Stock (Z. f. anorg. Chem., 39, 465 and 791; 1926) and appeared to be completely free from mercury.

and appeared to be completely free from mercury.

Since it was possible that, for purification, the carbon disulphide had been shaken with mercury, sulphur was added and the solution was boiled for two hours in a flask with a reflux-condenser. The solution was then distilled, and 200 c.c. of the distillate was examined. No trace of mercury was found, whilst a quantity of 0.001 mgm. mercury would have been detected easily. Now we started our definite sparking experiments at 160,000 volts and 10-20 milliamperes. Since we wished to work at this voltage, and the dispersed lead soon diminishes, the electrical resistance of the dielectric, causing a decrease of the tension, every time, as the voltage

began to decrease, the experiment was stopped until the dispersed lead had precipitated. After having sparked in this way discontinuously for one or two hours, the dispersed lead was gathered and examined. In 30 gm. of the mixture of dispersed lead and carbon, 0·1·0·2 mgm. mercury was found. The same result was obtained six separate times. Then our transformer went wrong, and it was some time before we could continue our experiments.

In the meantime I resolved to carry out an experiment, the results of which would be very convincing. It would be very important if it could be proved in repeating the experiment, after replacing only the lead electrodes by electrodes of another pure metal, of which no transmutation into mercury could be suspected, that the dispersed metal in this case is always free from mercury. I chose platinum; two platinum rods, 3 mm. thick and 4 cm. long, were mounted in the same steel-holders and the sparking experiments were repeated. The result was that the conglomerate of dispersed platinum and carbon was

found to be free from mercury.

On repeating this experiment, the result was the same; and the conclusion consequently was, that the mercury found in our sparking experiment with lead electrodes must have been formed from lead. I intended to send now a preparation of our mercury to Dr. Aston, whom I had asked to examine it in his mass spectrograph, but I preferred not to do so before we had repeated the platinum experiments several times. The third sparking experiment with platinum electrodes and with a new quantity of purified carbon disulphide gave, however, not a negative but a positive result, but not so strong as we found in our

experiments with lead electrodes.

Taking for the fourth experiment the carbon disulphide previously used in our third experiment, the result was again negative. From this it follows that the new quantity of carbon disulphide must have contained a trace of a mercury compound, probably a volatile organic one, which was not removed by the purification method applied, and it had escaped detection. Since the positive result, after sparking with platinum electrodes, had disappeared, it seemed that this mercury compound could be dissociated and removed by strong electrical discharges, and therefore we resolved to purify the carbon disulphide in future by the sparking method with platinum electrodes. The result of this method was excellent. After having sparked 750 c.c. of carbon disulphide for 1½ hours, the conglomerate of dispersed platinum and carbon was separated from the liquid, and the liquid was distilled. The distillate proved to be free from mercury. This was found not only by direct chemical analytical examination, but also by submitting the carbon disulphide to a repeated sparking process between platinum electrodes, and by examination of the conglomerate of platinum and carbon formed—about 7 grams. The conglomerate was now completely free from mercury. This carbon disulphide purified by electrical discharges was used in our next experiments with lead electrodes, I cm. thick and 3 cm. long. These experiments, repeated several times, have so far given only negative results. At the moment I am, therefore, inclined to conclude that the mercury found in our earlier sparking experiments came, certainly partly and perhaps entirely, from the carbon disulphide. This seems possible, since in these experiments a used quantity of carbon disulphide was supplemented by a new quantity of carbon disulphide purified in the ordinary way. But there is still this difficulty, that after sparking between the lead electrodes in carbon disulphide, purified in the usual way, the reaction was stronger positive than

after sparking in this dielectric between platinum electrodes, in the same circumstances as regards voltage, current strength, and time. Consequently, there is still an uncertainty, which probably will be

solved by our continued investigations.

Though the experiments, which have been mentioned here very shortly, have taken a full year, they are only the beginning of detailed investigations in different directions. Still, I feel obliged to make this communication, since I know that other investigators are repeating our sparking experiments with carbon A. SMITS. disulphide.

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#### Thyroid Gland and Plumage in Chickens.

In a series of experiments now being carried out with Brown Leghorn chicks concerning the relation of thyroid gland to plumage characterisation, some interesting results are already apparent in the thyroidectomised females The operation was carried out when the birds were 6 weeks old, and 3 weeks after

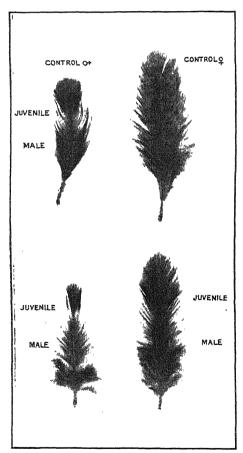


Fig. 1.—Wing contour feathers from Brown Leghorn chicks 10 weeks old. Upper figures, controls, lower figures, thyroidectomised female operated on at 6 weeks old.

the operation the effect on the plumage became visible. Changes in coloration first appear in the contour feathers of the wing, shoulder and cape, the whole forming a continuous arc of brightly coloured feathers from one wing edge to the other when the bird is examined with the wings outstretched. Examination of control male chicks at the same time showed a similar continuous band of brightly coloured feathers replacing the juvenile plumage in these areas, while no such band was present in the control females. In the region of the saddle, brightly coloured feathers were also observed in the thyroidectomised females and in control males, while being absent in control females.

When the feathers were sufficiently grown to determine their shape, it was seen that the majority of these brightly coloured feathers have the blunt tip characteristic of the juvenile feather. At a short distance from the tip, however, the shape changes abruptly, and in the proximal portion the feather is very similar to the typical male feather from the same regions, i.e. it is heavily fringed and tapers almost to a point at the junction with the distal juvenile portion This condition is also found in feathers from control males of approximately the same age (Fig. 1). The coloration of the male-like feathers in the thyroidectomised females, while markedly differing from female colouring, is not quite so deep as that of the feathers from control males.

It would appear thus that the removal of the thyroid gland from Brown Leghorn female chicks leads in the first place to the assumption of plumage of a type approaching in colour and form that of the male. These results are of special interest in view of the recent work on the effect of thyroid feeding on A. W. GREENWOOD. J. S. S. BLYTH. the plumage of the fowl.

Animal Breeding Research Department, University of Edmburgh.

#### Ultrasonic Stationary Waves.

THE observations described in the striking experiment of Hubbard and Loomis (NATURE, Aug. 6, 1927, p. 189) are another example of the important conclusions which may be derived from a study of the interesting phenomenon of ultrasonic stationary waves. Velocities of sound in various liquids were determined here by the ultrasonic stationary wave method some years ago; some of these results have already been published (*Trans Roy Soc. Can.*, 3, 141; 1923, 159, 191, 197; 1925; 79; 1927); others were reported to the Canadian Research Council (Report, Boyle and Morgan, 1924). The 'detector' of the standing waves in these experiments was 'nodal dust figures,' something like the figures in a Kundt's tube, but less precision was claimed for the results than is claimed by the authors above.

Pierce also carried out very precise experiments on the velocity of sound in gases (*Proc. Amer. Acad.*, 60, 6, 271; 1925) by the ultrasonic method, the detector of the standing waves in his experiments being a milli- or micro-ammeter in the associated grid-circuit of the electric generating tube. In fact, Hubbard and Loomis's experiment does for liquids what Pierce's did for gases, with the exception that their standing wave indicator is a neon tube instead of a milli-

ammeter.

The purpose of this note is to point out that the presence of these ultrasonic stationary waves in a liquid can easily be demonstrated and visualised by making use of another phenomenon, namely, that of ultrasonic cavitation, or the production of bubbles in the liquid by the waves themselves. In our work in this laboratory nodal layers of bubbles, a half wavelength apart, have been produced in a tank of liquid between an ultrasonic generator and a reflector; and some months ago Messrs. Taylor and Sproule arranged an apparatus for ultrasonic waves in which a hell-jar

was sealed to the face of an ultrasonic generator Liquid was poured in the bell-jar and the pressure in the air-space above it could be reduced by a connected pump. On working the generator, stationary waves were produced in the vertical column of liquid above it, the air-liquid surface serving as reflector pressure in the bell ar and the voltage applied to the generator could be adjusted to result in the production of either large or small bubbles in the liquid. When large bubbles were produced they rose rapidly through the liquid, but the small bubbles, especially at very high frequencies, could be made to stay suspended in the liquid in layers parallel to the reflecting The layers were half a wave-length apart, and measurements of wave-lengths and velocities could readily be effected. Our purpose, however, was not to measure wave-lengths but to study cavitation, on which subject papers are in course of publication.

The experiment is a very striking one, and in our work the nodal layers of bubbles were particularly regular and distinct at frequencies around 170,000 cycles per second. In addition, and as pointed out by Hubbard and Loomis, the column of liquid can be thrown into resonance, the condition of exact resonance in our experiment being indicated by a slight humping of the liquid at the free surface. The height of the hump depends on the intensity of the radiation, and if the liquid be slowly drained from the bell-jar the humping recurs every time the free surface passes through the nodal levels. In this way incidental measurements were taken of half-wave lengths and velocities

In all the determinations of velocity of sound by the ultrasonic method made in this laboratory in the last few years, we have found no detectable change of velocity with frequency. In solids or in liquids, within a range of frequency extending from 30.000 to 600,000 cycles per second.

R. W. BOYLE.

University of Alberta, Aug. 23.

# The Intrinsic Field of a Magnet.

Reasons have been given recently by J. Dorfman (Nature, Mar. 5, 1927, p. 353) and by W. Peddie (Nature, July 16, 1927, p. 80) against the view that there is in a magnet an intrinsic magnetic field of immense magnitude. It is true that an enormous intrinsic magnetic field explains simply, by analogy with the behaviour of fluids, how ferro-magnetic properties come into existence when a ferro-magnetic substance passes through the critical point from a high to a low temperature. By equating magnetic and thermal energies a formula can be obtained for the magnitude of this intrinsic field which at its maximum is, according to Weiss,  $3R\theta/\sigma_o$ ,  $\sigma_o$  being the maximum specific magnetisation,  $\theta$  the critical temperature and R the gas constant referred to two degrees of freedom of kinetic energy.

The calculation is made on the supposition that it is allowable to treat magnetic energy as the simple equivalent of the thermal energy and this leads to a value for the intrinsic field at its maximum of the order of 107 gausses, a magnitude so large that serious difficulties arise both in accounting for its origin and also in dealing with some of the facts of induced magnetism where, indeed, a small intrinsic magnetic field would be more appropriate. Undoubtedly forces of great magnitude exist within a magnet, but there are experimental grounds for concluding they are not such as give rise directly to ferro-magnetism. It seems necessary then to suppose that there are two fields within a magnet of different origin and magnitude,

one arising from magnetic forces—a true intrinsic magnetic field—and the other, and much the larger one, arising from toices which may provisionally be classed as molecular, and that there is some mechanism whereby one field can act upon the other. It is conceivable that this action is due to the magnetic ties existing between the magnetic molecules of a ferromagnetic substance, the effect of which is that translational movements of the molecules, controlled by the molecular forces and set up by the thermal agencies, give rise to rotational motion of the molecules, such motion being controlled only by magnetic forces. In this connexion Ewing's latest model of the ferromagnetic atom is helpful in showing that there may be a fixed and a movable part in the atom.

At a high temperature, when translational and consequently rotational movements are violent, orientation by an external magnetic field is so vigorously opposed that only paramagnetic qualities are in evidence. When, however, the metal cools, and elastic properties appear, the molecular forces which come into action restrict translatory motion, and consequently rotational motion subsides; as there is nothing to oppose orientation of the molecules except a small intrinsic magnetic field, ferro-magnetic properties come into existence. Thus it may be the molecular field of force and not an immense magnetic intrinsic field which brings into evidence ferro-magnetism.

This view explains how any rotational movement of the molecules, if set up by thermal agencies, must involve the energy of agitation of the whole mass, which will be very large, but if set up by magnetic agencies the expenditure of energy will be very small, which is what is observed experimentally. It is also consistent with the facts of the discontinuity of the specific heat at the critical temperature and of recalescence

Thus it is possible to reconcile the hypothesis of a very large intrinsic field which may have magnetic effects with the hypothesis that the field itself is not a magnetic field immediately controlling ferro-magnetism.

J. R. ASHWORTH.

Rochdale, Aug. 30.

### Photoelectric Emissivity and Sparking Potentials.

In a recent paper in the Proc.~Roy.~Soc. (A, 144, 73; 1927) I have described a photoelectric theory of the sparking potentials of discharge tubes. According to this theory the sparking potential  $v_c$  is a function of the photoelectric emissivity  $\gamma$ , of the cathode, for the radiation accompanying the neutralisation of the positive ions at the cathodic surface.

It has been found possible to complete experiments upon the concomitant measurement of  $v_c$  and  $\gamma$ , for the case of a parallel disc electrode tube, with helium

as the filling gas.

A measure of proportionality of  $\gamma$ , P, was obtained by radiating the cathode with radiation proceeding from a hot wire discharge box of special form, and measuring the photoelectric effect;  $v_e$  was measured in the usual way.

The variation of  $v_c$  with progressive purification of the helium by charcoal cooled in liquid air, was unexpected and remarkable. There occurred initially the well-known rapid decrease of the values of the sparking potential until a minimum value was attained. After this, a slow rise in sparking potential took place, until a value of anything from about 10 volts to 600 volts (according to gas pressure, etc.) higher than the minimum was attained.

Introduction of additional helium showed that the effects did not proceed from pressure changes.

Concomitant measurements of P showed a fall

from a maximum at the minimum sparking potential to a minimum at the final sparking potential

After considering a number of explanations of the

phenomena, the following was adopted.

(1) The helium rapidly becomes pure, so that only slight traces of foreign gases remain, a fall of  $v_{\bullet}$ occurs to a minimum, and the properties of the gas then remain almost constant

(2) The gas layer on the surface of the cathode undergoes slow change, probably by evaporation of the surface gas molecules into the helium and final disappearance in the charcoal This slow change of the cathode surface diminishes progressively its photoelectric emissivity, and increase of  $v_c$  occurs until the modification of the cathode has attained equilibrium

under the existing conditions.

It was determined, for various pressures, that throughout this region the graphs showing the relation between the corresponding values of  $v_c$  and P were smooth curves, and the relation between  $\log~1/P$  and  $v_{\rm e}$  was either linear or of slightly curved form. The quantitative agreement with the equations given in the above mentioned paper was good. We may conclude, therefore, that the results give strong evidence in favour of the photoelectric theory of sparking potentials.

JAMES TAYLOR.

Physical Institute of the University of Utrecht, Sept. 14.

# Sub-Grain Boundaries in Nickel.

Referring to the communication of Messrs. C. J. Smithells and H. P. Rooksby in Nature of Aug. 13, p. 226, concerning their own and Mr. F. S. Tritton's observations on sub-grain boundaries in tungsten

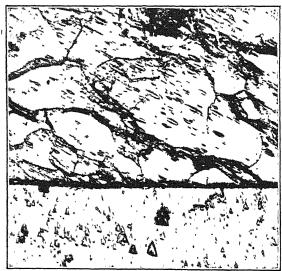


Fig. 1 —Photomicrograph of nickel, deeply etched in concentrated mitric acid.  $\times 200$ 

and iron, it may be of interest to record that we have observed a similar structure in nickel, as illustrated in the accompanying photomicrograph (Fig. 1). This particular specimen was melted in an atmosphere of hydrogen, cooled rather slowly until below the solidification point and then somewhat more rapidly to room temperature.

The micrograph shows portions of two large grains, with a main grain boundary running parallel to one

Sub-boundaries may be edge of the photograph seen in the upper grain Deep etching has resulted in a number of etching pits which are seen to be uniformly oriented within the main grains, thus confirming the observations mentioned above will also be noted that the sub-grams have a slight elongation (suggestive of cold-working) parallel to the direction of the etching pits E. S. DAVENPORT

Westinghouse Lamp Co, Bloomfield, NJ, Aug 25.

#### Poor Common Salt!

' Some books are lies frae end to end," says Burns. Scientific (save the mark) speculation would seem to be on the way to this state! Thus on p 405 of NATURE, of Sept. 17, in a letter on Prof Lewis's light corpuscles, the statement is made by the writer, that a 'speculation,' by Prof. Lewis, about the quantum, "is repugnant to common sense." Again, on p 414, Prof. W L. Bragg asserts that "In sodium chloride there appear to be no molecules represented by NaCl The equality in number of sodium and chlorine atoms is arrived at by a chess-board pattern of these atoms; it is a result of geometry and not of a pairing-off of the atoms"

cricket. Chemistry is neither chess nor geometry, whatever X-ray physics may be. Such unjustified aspersion of the molecular character of our most necessary condiment must not be allowed any longer to pass unchallenged. A little study of the Apostle Paul may be recommended to Prof. Bragg, as a necessary preliminary even to X-ray work, especially as the doctrine has been insistently advocated at the recent Flat Races at Leeds, that science is the pursuit of truth. It were time that chemists took charge of chemistry once more and protected neophytes against the worship of false gods at least taught them to ask for something more than chess-board evidence.

HENRY E ARMSTRONG.

# Solution of the Equation sin $\theta/\theta = c$ .

An approximate solution of the equation  $\frac{\sin \theta}{\theta} = c$ , where  $c \longrightarrow 1$ , may be got in the following manner. By putting  $\sin \theta = y$ , transform the equation to  $\frac{\sin^{-1}y}{y} = \frac{1}{c} = K$  say. The approximate solution of this equation is given by  $y_a = 8\frac{\sqrt{(3K-3)(3K+5)}}{(3K+1)^2}$  which can be evaluated by logarithms Using  $\sin \theta_a = y_a$ , we can find  $\theta_a$ , an approximate solution of  $\frac{\sin \theta}{\theta} = c$ . If  $\theta_a$ be in the neighbourhood of 5° we subtract 1" to get the answer to the nearest second  $\,$  If  $\theta_a$  be less than about 3°, the value of  $\theta_a$  will give us the answer to the nearest second.

In any case, the significant figure of the error (E) may be got by using  $E = \frac{3\epsilon}{A} \left( -\frac{1}{2} + \frac{1}{Ay_a^2} \right)$  where

$$\epsilon = \frac{(\sin^{-1}y_a)^5}{4|5}, A = \frac{3K+1}{4}$$

 $\epsilon = \frac{(\sin^{-1}y_a)^5}{4 \mid 5}, \ A = \frac{3K+1}{4}.$  The true value (y) can then be got by using  $y_a - y = E$ . V. Naylor.

H.M. Dockyard School, Devonport.

No. 3022, Vol. 1201

# The Safety in Mines Research Station near Buxton. By Prof H. B Dixon F.R.S.

IN moving the Mines Experimental Station from Eskmeals, on the Cumberland coast, to Harpur Hill, near Buxton, the Safety in Mines Research Board has sought and has found an equally secluded site in a more accessible district The choice of such a site in the England of to-day is no easy problem. It must be near a railway so that a siding can be run into it, it must be near a water supply; it must not be near houses or a main road, or indeed near any public path, and, if possible, it must not interfere with the amenities of the neighbourhood Among the sandhills of Eskmeals there was seclusion enough, and the gunrange of Messrs Vickers on the adjoining site afforded both access by rail and immunity from complaint of 'explosion-shock.' But Eskmeals

had two drawbacks; it suffered from sandstorms often, and from inaccessibility at all times

Though hidden by the folding hills, the station at Harpur Hill can be reached in about ten minutes from Buxton, whence lighting gas and water are obtained. The site comprises more than 400 acres and gives a wide 'danger area' on either side of the steel explosion galleries Indeed, the site of the galleries was used for testing guns and various bombs during the War; the nearest works, adjoining the site, are limestone quarries where blasting is constantly in operation.

While the scientific instruments at Eskmeals on the seashore suffered from sand and

salt-spray, the high level of Harpur Hill (1200 feet above the sea) may expose the workers to greater extremes of weather. Great care, however, has been taken to afford protection to the instruments installed, and the observation-huts and experimental chambers are substantially built in concrete.

The two largest buildings on the site may be described as the Administrative Block and the Machinery or Works Block The first contains a row of offices for the staff, flanked at one end by a conference and lecture hall, and at the opposite end by a large laboratory and dark rooms for research work.

Facing these offices the large works building is erected. It is rectangular in form with a central corridor—through which the light railway runs. On one side are the store-rooms, the machine shop, and the blacksmith's shop; on the other side are the battery-house, the power-house, the joiner's and the electrician's shop. There is also a canteen and a cook-house, and ample lavatory and bathroom accommodation for the workmen, as well as arrangements for drying clothes. From the power-house electric current is supplied to the various centres by two circuits—at 110 volts and 220 volts.

For the transport of heavy material a siding

has been run from the High Peak line (L M & S. railway), and material can be unloaded here on to a concrete platform or into the waggons of a 3-feet-gauge railway by a cross-travelling gantry crane spanning the siding and the unloading platform. The 3-feet railway runs to the works block and to the various research buildings on the site; it also runs along the full length of the steel explosion galleries

# THE EXPLOSION GALLERIES.

The longer gallery, 1008 feet in length, is made up of 40 sections of mild steel tubing 4 feet in diameter and  $\frac{5}{8}$ -inch thick. These sections are bolted together gas-tight by means of broad flanges compressing asbestos and wire-rope packing.

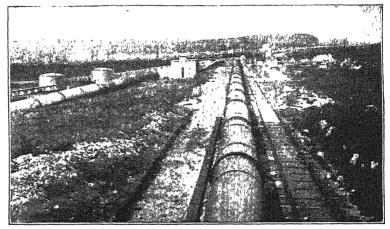


Fig. 1 — View from a bridge across the middle of the 4-ft gallery Reproduced from Paper No. 34 of the Safety in Mines Research Board by permission of the Controller of H M. Stationery, Office

These packing rings simplify the removal of any section, and permit the insertion of a restriction plate at any of the junctions. To prevent distortion of the tube by jumping or 'whipping' during an explosion, each section is bound down on to its concrete cradle by two steel bands anchored into the solid rock below. While the southern end of the gallery is open the northern end is closed, but connects at right angles through a moveable valve to the drift leading to the fan-house. The ventilating fan can create an air current in either direction through the gallery of 1200 feet per minute. A view of the 4-foot gallery is shown in Fig. 1, with the fan-house in the distance and the larger  $7\frac{1}{2}$ -foot gallery on the left

The object of the long gallery being the study of the nature of a coal-dust explosion as it is developed and progresses through its various phases, much care has been expended on obtaining exact records of the passage of the flame and the degree of pressure exerted at fixed points along the gallery. To secure these records instrument-cabins have been erected every 100 feet. They are built of steel plates on concrete foundations; they are close to, but are not fastened to the gallery.

In each cabin a horizontal strip one foot wide has been removed, so that the instruments may be placed on shelves directly attached to the gallery, therefore as the gallery moves longitudinally with changes of temperature the shelves and their instruments travel with it without any strain. To read the pressures developed in the gallery the U.S. Bureau of Mines manometer has been adopted. In this instrument (shown on its shelf in Fig. 2) the pressure acts through a short tube on a cast-

one side of the sensitised paper, which shows the duration and intensity of the flame, and also indicates if periodic vibrations of flame have been set up. Each manometer is separately calibrated by subjecting it to known pressures after each series of tests. The manometer records are finally read on a special drum through a low-power microscope fitted with cross-wires.

For measuring the speed of flame along the gallery, bronze plugs are arranged to screw into

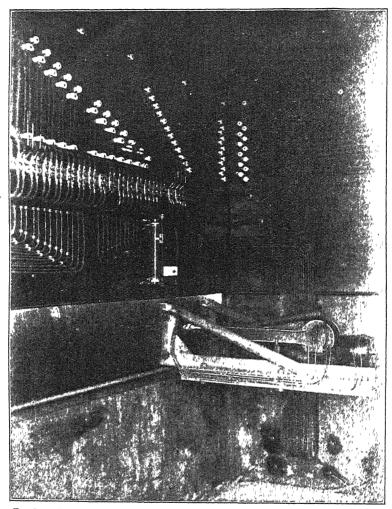


Fig. 2.—4-ft explosion gallery. Interior of No 5 instrument cabin, showing distribution of electric circuits and method of mounting manometer.

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steel diaphragm, the movement of which is communicated to a small concave mirror of stainless steel focussing, a point of light on to a rotating drum carrying sensitised paper. The arrangement is such that the movement of the diaphragm is magnified 150 times in the displacement of the light image on the drum, the speed of which is registered electrically on a chronograph at the firing-station. In addition to acting as a manometer, the instrument also serves to register the passage of flame past a small thick glass window fixed in the side of the gallery. The light, when the flame illuminates the window, is focussed on

the roof at intervals of 100 feet. They carry insulated steel rods 3 inches long, between which are stretched fine-gauge tim wire—to be fused by the flame, but not broken by a pressure wave. In each cabin are arranged the electrical switches to connect the flame circuit-breaker to the chronograph in the firing-station (Fig 2).

# THE LARGE AND SMALL GALLERIES

The  $7\frac{1}{2}$ -feet gallery, a portion of that used at Eskmeals, has been erected for a length of 400 feet, and will be employed for demonstrations of the explodibility of pure coal-dust when it is raised

in a cloud in air and ignited. This gallery will also be used for other large-scale experiments—for example, to determine the distance to which the flame of an explosion of fire-damp is projected along a gallery. For this latter investigation 50 feet of the gallery is separated from the rest by a sliding shutter, which can be opened when the methane and air in the 50-feet chamber are thoroughly mixed. The distance travelled by the projected flame is measured by the burning of thin sticks of cordite attached to the roof every 10 feet in the open gallery beyond

Parallel with the large gallery the 1-foot tube, 300 feet long, is formed of sections bolted together by means of flanges—the joints being made airtight by asbestos rings. Between any two sections a steel 'restriction-ring' can be inserted in order to diminish the diameter of the tube and produce reflexions and turbulence

The gas and air can be circulated and thoroughly mixed by means of a fan and a by-pass tube running

the whole length of the gallery This tube will be used to study the development of fire-damp explosions as the flame travels forward, both when the bore is smooth and uniform and also when the flame meets with surfaces which reflect pressure waves or cause turbulence by forcing the flamefront through smaller openings. Such restrictions, when tried on a small scale, have been shown to have remarkable effects on the travel of an explosion flame, the 1-foot tube will give the means of studying gas explosions with a larger volume of gas and a greater run' of flame than is possible in a laboratory experiment.

#### HIGH-EXPLOSIVES RESEARCH.

One of the most interesting of the new buildings is that devoted to research on the nature of the shock and flame produced by high explosives.

Plant has been installed to photograph by the Schlieren method the progress of the shock-wave through air, and also to record the movement of the flame and of the products of combustion when a high explosive is defonated in a cannon. A large concave mirror of stainless steel focusses the light from an arc lamp on to a moving film across the path of the shock-wave which refracts the beam. The movement of the pressure-wave is thus recorded in the wave-speed camera, which also serves to photograph the motion of the flame itself and of the products of combustion. The speed of the shock-wave in front of the flame, and its gradual dying down as it spreads in free air, are recorded and timed. The conditions for blanketing the flame by the burnt gases of the explosion—a sure protection against fire-damp ignition—can thus be investigated.

For the testing of explosives to be used in coalmining a steel gallery 60 feet long and 6 feet in diameter has been erected. One half of this is the gas chamber, separated from the other half by an oiled-paper diaphragm, and with a central opening at the other end 12 inches in diameter. When the gun is charged it is run up on rails so as to cover this opening—making a tight joint by means of a rubber-washer fixed round the rim of the opening. The methane (or other gas) is filled into the chamber through a meter, and the gas and air are thoroughly mixed by a circulating fan and a bypass tube. The flame can be watched through two thick glass windows in the side of the gas-chamber from an observing station 60 feet away

#### GOB-FIRE RESEARCH CHAMBER.

Another novelty is the structure (of reinforced concrete) to be devoted to the study of gob-fires. The building consists of a central chamber 30 feet square and 8 feet high, simulating a mine goaf, with a passage 6 feet wide running round it. Between the central chamber and the passage are three openings with steel sliding doors operated

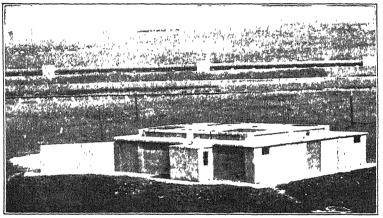


Fig. 3 —The chamber for research on gob-fires — In the background is the 1-ft gallery and beyond is a portion of the long 4-ft gallery.

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from outside the building. A fan is arranged to deliver a current of air into the passage, and this can be distributed as desired through the goafchamber, into which fire-damp can also be introduced by pipes in the floor leading from a gasholder. Two control cabins are built against the outer wall, and in these the temperature of any part of the inner chamber can be read off from thermo-couples fixed in metal sheaths, and samples of air and gas can be collected from positions either in the coal heap or outside it by means of 4-inch metal pipes protected from fouling by filter-caps fitted to the inner ends. The design of the building (which is illustrated in Fig. 3) is to determine the limiting conditions necessary for the production and ignition of an explosive gas mixture behind a stopping, and to study the methods of sealing off a fire so as to avoid the danger of such conditions arising.

The slow-smouldering of coal-refuse in the goaf has often led to fires, difficult to extinguish, and dangerous because of the inflammable gas distilled from the heated coal. But the conditions under which such gas becomes dangerous are at present little known, and they demand skilled investigation.

# The Englishman of the Future.1

By Prof F G PARSONS.

T has been borne in upon me, little by little, that some of the characteristics of the Englishman of to-day do not seem to be hereditary at all, and that in some things we, in our development, are not following any Mendelian laws, nor are we harking back to Long Barrow, Bronze Age, Celtic, or Saxon types, but that gradually we are building up a new kind of man, differing in certain ways from all of these.

Feeling sure that a change is coming over our younger generation, let us try to see where it is leading, and whether heredity or environment is taking the greater share in guiding it, though we shall surely be wrong if we allow either of these great influences to leave our minds for a moment I must be careful not to undertake more than I can carry through in my time, and therefore I will only ask you to let me say a little about the three physical characteristics of stature, coloration, and head shape, in order to see whether anything may

be learnt from these

I suppose that no one would dare to say what the average height of the modern Englishman is, because we have no State-controlled and State-aided means of sampling the physical conditions of our population in any way. I can state at first hand that the men of our labouring and agricultural classes in the Chilterns average 5 ft. 6 in., and that the mixed classes in a North Kent doctor's practice are 5 ft. 7 in.; but what we do not know is how much the stunted millions in the Midland manufacturing towns, and the mass of unemployed and unemployable humanity in the east of London, will pull this down. I suppose that, taking these into consideration, the average height of the Englishman to-day is not more than 5 ft. 5 in; though when we speak of the well-nourished classes there is a different tale to tell. I know, for example, that for the last twenty years my students at St. Thomas's Hospital have averaged 5 ft 9 in. and in no single year have they ever risen so high as 5 ft. 10 in. or dropped below 5 ft. 9 in.; but, steady though their average at this height has been for twenty years, I am quite sure that they are taller than were my own contemporaries forty years ago, just as those contemporaries, in their turn, were probably taller than the originals of Bob Sawyer's and Ben Allen's fellow-students, who walked the Borough hospitals nearly a century ago.

I think, therefore, that hygiene and better nutrition have done their work so far as stature is concerned. It may be that the more intensive health crusade of the last two or three years may cause a new rise in stature which has not yet had time to show itself, but I can see no signs of it as yet may be, too, that, though environment may have played its last card, heredity may not have done so, and that if for any reason the individuals with a higher percentage of Nordic traits in their patch-

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work composition are put in a more favourable position to marry and beget offspring than those with a large number of Alpine and Mediterranean traits, the stature may rise still further.

I feel sure, however, that there is a certain average height beyond which the purest Nordic stock will not rise, and my belief is that this has been reached, or nearly reached, already—so far

as the higher classes are concerned.

We have learnt how to raise our male stature to a point beyond which it will not go, and beyond which it is not well that it should go. But what of the woman? About twenty years ago I measured the height of some 150 students of the School of Medicine for Women, and found their average to be 5 ft. 3 m., but after ten years their successors had added a fraction over an inch to their stature; while this year I have measured 150 nurses and massage students at St. Thomas's Hospital, whose

average height was 5 ft. 4.9 in Now these girls belong to the very same class of the community as the male medical students; indeed there are brothers and sisters in the two groups, and the difference with which they have reacted to altered conditions is interesting; for, whereas the boys had reached their full average of 5 ft 9 in. when first I measured them twenty years ago—and their successors, year by year, have never added anything to, or lost anything from, their height, up to the present—their sisters have gained very nearly 2 inches in the twenty years, and practically have reached the height of the average Englishman, whom we dare not estimate as measuring more than 5 ft 5 in. There are no signs, moreover, that these healthily nourished girls have reached their maximum, as have the

One often hears that the English people are becoming darker. To me the simplest index seems to be gained by adding half the number of the intermediate eyes to the light and half to the dark, and by then taking the new percentage of dark eyes as the index of eye coloration. In most cases it is unwise to use the hair or eyes alone, but to combine the two into a general index of nigrescence by adding the indices of the hair and eyes together

and then dividing the sum by two.

I must be content, at this stage, simply to give some massed results in trying to solve the question whether Londoners, who practically are southern English people, have grown darker or fairer during the last sixty years.

The following table gives the material which I have:

	AI	OULT MALES.			
1860 1927	Hair Index 39.7 (2400) 27.4 (1485)	Eye Index. 35.7 (2400) 33.2 (1485)	Nigrescence Index. 37.7 (2400) 30.3 (1485)		
Adult Females.					
$\frac{1860}{1927}$	42.7 (2813) 23.9 (1487)	40 7 (2813) 35 3 (411)	41·7 (2813) 29·6 (949)		

<sup>&</sup>lt;sup>1</sup> From the presidential address to Section H (Anthropology) of the British Association, delivered at Leeds on Sept 2.

BOYS (8 TO 16 YEARS OLD)

1927 8.7 (2565) 33 1 (2565) 20 9 (2565)

GIRLS (8 TO 16 YEARS OLD).

1927 11.0 (1922) 34 3 (1922) 22.6 (1922)

On looking at this table one cannot fail to be struck by the increase in fairness, particularly in the hair; but I do not wish to press it too far, because there are so many possible sources of error. Not only is there the possibility that Beddoe and I had a different border-line between brown and dark brown hair, but other things, such as the modern habit of wearing the hair short, the habit of more frequently washing the head, and the disuse to a considerable extent of pomatum and grease, all give an appearance of fairness which was wanting sixty years ago In the eye records I place more faith, for both Beddoe and I used an intermediate group between the light and dark eyes, a group which I have divided in both sets of records equally between the light and the dark. The drop in the darkness here is not serious, but I think that it is large enough to be significant.

The children's records at first seem irrelevant, since I have nothing of sixty years ago with which to compare them. Their use is to supplement the present-day eye colours of the adults, especially those of the women, which are very scanty. It will be noticed that in children of eight to sixteen the eye colours have become permanent, though the hair has not, and thus their evidence is valuable.

These records, which run into several thousands, do not give us any reason to think that the Londoner is becoming darker, but do give us reason, though it may need discounting, to believe that he is growing fairer under changing conditions.

The last point to which I wish to direct attention is head shape. The anthropologist usually thinks of skulls in terms of their length and breadth, and certainly he has gained a great deal of useful information in the past from this cranial index; lately, however, he has felt that something more is needed, and specialists in craniology have piled up a mass of arcs, indices, coefficients, and angles reason why the cranial or the cephalic index is not enough is that it treats the head as if it were a structure of two, instead of three, dimensions To use a homely simile, it is like giving the length and breadth of a box and then expecting the hearer to grasp what that box is like. We have hundreds of thousands of records of the length and breadth of heads, but very few of their height. I submit that, if we use all three dimensions—length, breadth, and height—together, a standard will be gained which roughly will represent the size of the skull, and with this each dimension may be compared, and a proportional index for each established. The most accurate method, no doubt, is to take the product of the three dimensions and then to extract the cube root and multiply it by three. The result of this is a standard by which the length, breadth, and height of the skull may be divided, and in this way proportional indices obtained which will bear a definite relation to the size of the skull.

Unfortunately the process, though soon learned, is tiresome and needs a logarithm table, which is not always to hand.

A much simpler, and for all practical purposes an equally valuable method of gaining proportional indices, is to add together the length, breadth, and height of the skull, and then to divide each dimension by the sum thus obtained. This gives a series of indices which are, on an average, 0 006 lower than those which the cube-root system supplies; but in no case does this alter the relative position of any of my series of British skulls.

We are fortunate enough to have two independent sets of measurements of the three main stocks which went to the making of the Englishman—the Mediterranean, represented by the Long Barrow or Neolithic Race, the Alpine, represented by the Beaker Folk; and the Nordic, represented by the Anglo-Saxons. One of each of these three sets has been measured by myself, and the other has been measured or collected by Mr. Morant, who published them in Biometrika—If we add the proportional indices of the three stocks together and divide them by three, the result is as follows:

			Length	Breadth	Height	
Morant Parsons	:	•		$\begin{array}{c} 0.3200 \\ 0.3210 \end{array}$		=1 0000 =1 0000
Mean	•	,	0.4195	0.3205	0.2600	=1 0000

This result, surely, is as close as two people working upon different samples and different numbers of skulls of the same races could be expected to reach; and there is every reason to believe that the mean between the two sets of results is more likely to be nearer the truth than either of them taken separately, and ought roughly to represent what we should be likely to find, in the descendants, if equal numbers of Long Barrow folk, Beaker folk, and Anglo-Saxons were mixed and allowed to interbreed.

Let us compare this with the records of the Northamptonshire people who lived at Rothwell in the fourteenth and fifteenth centuries:

	Length	Breadth	Height	
Mean of Long Barrow, Beaker, and Saxons Rothwell Hythe	0·4195	0 3205	0·2600	= 1·0000
	0 4180	0 3230	0 2590	= 1·0000
	0·4090	0·3300	0 2610	= 1·0000

This shows that if we evolve the kind of skull which a mixture of the three main stocks which we know went to the making of the medieval Englishman would produce, we get a form which, in its proportional length, breadth, and height is almost identical with that found in the Midlander of the Middle Ages

When, however, the Hythe crania are compared with these, we see at once that they must have had a different parentage; and what that parentage

is becomes plain when they are placed in company with the Beaker folk

	Length	Breadth.	Height	
Hythe Mean of Morant	0 4090	0.3300	0.2610	=1 0000
and Parsons' Beaker Folk	0 4035	0 3325	0 2640	=1.0000

It seems to me clear that these Hythe people, in the fourteenth and fifteenth centuries, were the result of an incursion and settlement of people from the Continent, of the Alpine Race, who had been slightly, but only slightly, modified by mixture with the Kentish folk

In the eighteenth century the Londoners who lived in the neighbourhood of Clare Market had skulls the proportional dimensions of which differed very little from those at Rothwell:

	Length	Breadth.	Height		
Rothwell Clare Market .	0·418 0·421	0 323 0·322	0·259 0 257	= 1 000 = 1 000	

Apparently, however, there was a little more of the Nordic and a little less of the Alpine element about them.

In the seventeenth century three series of plague skulls are available and were described by Macdonell and Hooke. They are remarkable for their low vaults and receding foreheads, and it has been suggested that they show that the modern Londoner has reverted to the Early Iron Age type, though formerly Pearson regarded them as Long Barrow in their characteristics. Unfortunately we know very little of the craniology of the Early Iron Age. We must therefore let this suggestion stand over until more work has been done upon the head shape of the Iron Age. There is one point, however, which I think should be borne in mind, especially since the Londoners seem to have gone back to a more normal head height in the eighteenth century; it is that during the plague the better class of citizens fled from the city, leaving the dregs of the population behind, and it is in these dregs that receding foreheads and low cranial vaults are most likely to be found. I cannot think that it is wise to use plague skulls as types of seventeenth-century Londoners as a whole.

Now we come to a new and striking development. Until the eighteenth century, the only skulls which show a proportional auricular height of more than 0.260 are those belonging to the Alpine Race, that is to say the Beaker Folk and the Hythe people. Bearing this in mind, it is interesting to notice that in the early nineteenth century the proportion of the head height of English soldiers was 0.262, while in the men of the Royal Engineers, measured by Benington in the early part of the twentieth century, it had risen to 0.267, and in the patients at St. Thomas's Hospital in the present day it is 0.271.

These last three examples are of the less welleducated classes, and even in these it is remarkable

how the proportional height of the head has risen well above anything which any of our ancestors can show, even were we to claim the Beaker Folk as our main ancestors, which all the evidence tells us would be unjustifiable.

When we come to measure the educated classes of the community, which have enjoyed a greater share of the modern, improved conditions of environment, the result is still more striking, for we see the members of the British Association with a proportional head height of 0 271, the St. Thomas's Hospital students with 0 272, the Oxford undergraduates with 0 272, a number of British anatomists who met in Dublin in 1898 with 0 275, and the University College staff with 0 278.

I can see no signs of heredity or harking back to any known ancestry in the change which is coming over the English head, but only signs of reaction to

we ought to know.

over the English head, but only signs of reaction to environment. Is it not reasonable to think that, as the improved conditions of life are gradually shared by all classes, this change in the head shape will gradually become more general until the Englishman of the future is a man with a very differently proportioned head from that of any of his ancestors? I do not wish to decry the old cranial index; it has helped us much in the past, it will help us much in the future. All that I would say is that unless we take the proportional height into account we shall miss a great deal that

To sum up, I am left with the belief that the Englishman of the future is, if present conditions persist, making for an average height of 5 ft. 9 in., and the women for one of 5 ft. 6 in. or 5 ft. 7 in. That our people have reached, and are stationary at, a stage in which some 66 per cent. have light eyes and some 34 per cent. dark. That there are no signs whatever that the hair colour has darkened during the last sixty years, though there are signs, which perhaps need discounting, that the hair is lighter than it was sixty years ago. That the head shape is showing unmistakable signs of an increase of its proportional height, with a decrease of its proportional length, and that this increase of proportional height is greater than has been found in any of the stocks from which the modern Englishman is derived. It therefore cannot be looked upon as a harking back to any ancestral form, but must be regarded as an evolutionary process, in harmony with the greatly changed conditions of life which have come about during the last century.

After all this suggestion, which a study of the head height presses upon us, is one which many have held for a long time. If we accept it I fear that many of the sentimental attractions of British anthropology will be lessened, since there will be greater difficulty in determining whether the modern Englishman has more Saxon, Neolithic, Alpine, or Iron Age blood in his veins; and we must realise that he is becoming an individual who could not be formed by any possible combination of these stocks without the aid of external influences. Heredity alone, therefore, will not account for the Englishman of the future.

# Cave Painting from Griqualand East.1

By Dr Sidney H Haughton

THE large slab covered with paintings, a portion of which is reproduced herewith (Fig. 1), has a height of 3 feet and a length of 7 feet 10 inches It is obviously incomplete, and forms but part of what must have been a larger mural painting

The slab, which is in the collection of the South African Museum, was obtained for the Museum in the year 1912 by Mr G S T Mandy He disThe painting is probably one of the finest of its kind hitherto found in the Cape Province, and is remarkable not only for the coloration but also for the attention paid to details. The nature of the polychrome colouring can be compared with that of the wall-paintings of Altamira

The scene depicted is that of a herd of elands surrounded by hunters armed with bows and arrows

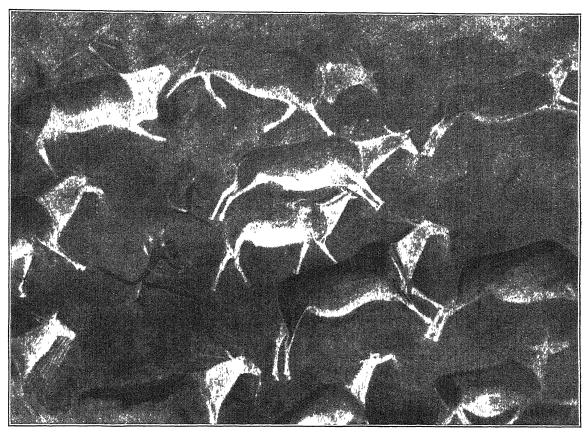


Fig. 1 —Part of polychrome painting on the Zaamenkomst slab Scale about one-sixth natural size.

covered it in a cave on the farm Zaamenkomst, which lies about 12 miles from the town of Maclear in Griqualand East. The slab was lying, in two parts, face downwards, in ash which covered the floor of the cave, and must have fallen either forwards from the wall of the cave or downwards from the roof. There is no evidence available to settle this point. From the ash and debris on the floor of the cave no artefacts or other evidence of occupation have been recovered. No traces of paintings were found on other large slabs which lay in the ash, but on the walls were remains of other scenes showing an entirely different technique.

and also with battle-axes. The hunters are running rapidly, this impression being conveyed by a conventional drawing of the outstretched legs. The animals are depicted as foaming at the mouth, and, in one instance, approaching death is indicated by the presence of bloody foam. The details of the animal figures are far more realistic than those of the men; but the presence of head-plumes and battle-axes as part of the equipment of the hunters lends peculiar interest to the scene, for these would seem to indicate that the men were not Bushmen but Bantu. The late Dr Péringuey considered that the bows and arrows depicted are of the type used by the Barotse and other Zambezi tribes.

<sup>&</sup>lt;sup>1</sup> Reprinted from a paper entitled "Note on the Zaamenkomst Slab" in Trans Roy Soc South Africa, vol. 14, part 3, 1927.

# Obituary.

SIR ARTHUR EVERETT SHIPLEY, G B.E, FRS IT is impossible for me to write without a profound sense of personal loss on the death of the first of the new scientific friends whose acquaintance I made as a freshman at Cambridge in the Michaelmas term of 1880, and with whom I was closely associated during the next twenty-eight Shipley obtained a first class in the Natural Sciences Tripos of 1882 (Part 1) and 1884 (Part 2), and his scientific contemporaries included Adami, Bateson, Chree, Fitzpatrick, J R. Green, Harker, Head, Sherrington, Threlfall, and D'Arcy Thompson In the interval between the two parts of his Tripos he had spent several months at the Zoological Station at Naples, the results of his studies being contained in his first scientific paper, on Brachiopoda (Argiope) He did not specially follow up this line of investigation in later years, but his continued interest in the subject is shown by the fact that he wrote articles on Brachiopoda for "The Cambridge Natural History" (1895) and the "Encyclopædia Britannica" (1902)

The atmosphere of Cambridge in Shiplev's undergraduate days was eminently calculated to encourage and stimulate the imagination of pupils who were ready to take an interest in science. Liveing, Humphry, and Michael Foster had been mainly instrumental in establishing the claims of natural science to an honoured place in the University. Lord Rayleigh was Cavendish professor, and zoology was represented by Alfred Newton as professor, supported by J. W Clark in charge of the Museum, and by F. M. Balfour and Sedgwick at the laboratory. Vines, a member of Shipley's college, was engaged in teaching botany on modern lines. Balfour had given a great impetus to the study of embryology; and his personal qualities, no less than the scientific eminence he had achieved, endeared him to his pupils in a way few teachers are beloved. The news of the Alpine accident in 1882, which cut short his brilliant career in early life, was, I think, first broken to me by Shipley, and it produced on us a supreme consciousness of personal grief. Balfour's example had had its influence, and Shipley took up the study of vertebrate embryology, producing, in 1887, a memoir on the development of the lamprey. Soon afterwards he turned his attention to the Gephyrean worms, an interest which he maintained for many years, his first substantial paper on this subject having appeared in the Quarterly Journal of Microscopical Science (1890). He afterwards contributed a series of papers on this group to this and other journals, and he described the Gephyrea collected by various expeditions, including those of Prof. Stanley Gardiner to Rotuma and Funafuti and the Maldive and Laccadive Islands, and of Dr. Arthur Willey to the Loyalty Islands and New Britain.

Shipley's interest shifted, in later years, to aspects of zoology which are not merely academic. So early as 1889 he had contributed to the *Kew Bulletin* a note on beetles destructive to rice-crops

in Burma, and he continued to take a special interest in economic entomology, a subject which is predominantly represented in his charming 'Minor Horrors of War'' (1915) and "More Minor Horrors" (1916) He was largely instrumental in the inception, by the Colonial Office, of the Imperial Bureau of Entomology, which was established in 1909, at first under another name, with Lord Cromer as its first charman

A substantial part of Shipley's scientific work was concerned with parasitic worms, with one or two papers on the Pentastomida, curious wormlike parasites which appear to be degenerate Here, too, the practical side of the Arachnida subject made a special appeal to him, as for example in his work for the Departmental Committee on Grouse Disease, and for the report to the Ceylon Government on the pearl oyster fisheries His sense of humour was stirred by the reflection that a lady wearing a pearl necklace is usually not aware of the fact that the production of a pearl may have been due to the effort of the mollusc to protect itself against a young intrusive tapeworm.

In 1893, Shipley produced his "Zoology of the Invertebrata," a text-book which has been largely used by students; and he collaborated with his friend Prof. MacBride in the preparation of another text-book ("Zoology"), which appeared in 1901 and has had an equally successful career. He had previously been associated with Dr. Schonland and Prof. Poulton in issuing as an English translation Weismann's "Essays upon Heredity," a work which greatly assisted in familiarising English readers with Weismann's work He was joint editor of "The Cambridge Natural History," which appeared in ten volumes from 1895 to 1909, and editor of the Pitt Press Natural Science Manuals (Biological Series) and of the Fauna of British India Series. He was perhaps at his best as a popular exponent of zoology His writings in this capacity, in the columns of the Times and elsewhere, abound in humorous touches which give them a specially readable and attractive quality, and they include many acute observations made by himself during his numerous journeys to the United States and other parts of the world

Shipley was born at Datchet on Mar. 10, 1861, and was educated at University College School and for a short time at St. Bartholomew's Hospital He entered Christ's College, Cambridge, in 1880, and became successively Fellow and Master of his College and Vice-Chancellor of the University He took a substantial part in lecturing, and for many years he was secretary to the Museums and Lecture Rooms Syndicate, a position involving the practical management of many of the affairs of the numerous buildings under his charge His capacity for work was unlimited, and he did very notable service to his College and University, and to the country generally, particularly during the years of the War. As early as 1887 he was sent by the Colonial Office to the Bermudas to investi-

gate a plant disease, and late in life he was specially concerned in the establishment of the Imperial College of Agriculture in Trinidad, which he visited on more than one occasion and of which he was chairman He was also chairman of the Council of the Marine Biological Association, a member of Royal Commissions on the Civil Service, Trinity College, Dublin, and the importation of store cattle and of the departmental inquiry into grouse disease, and he was a trustee of the Hunterian, Tancred, and Bert Foundations His scientific distinction was recognised by honorary degrees conferred on him by Princeton, Michigan, and Philadelphia, and by being made foreign member of the American Association of Economic Entomologists and of the Helminthological Society of Washington, and honorary member of the Société Zoologique et Malacologique de Belgique His period of office as Vice-Chancellor of the University of Cambridge, in 1917–1919, was described by the Times of Sept. 23, in an interesting account of the invaluable services which he performed for the country, fitly recognised by the award to him of the GBE in 1920. He died at the Master's Lodge of Christ's on Sept 22

Few men have had a wider circle of friends than Shipley, whose gifts of sympathy made him

persona grata to all sorts and conditions of men, from cabinet ministers to undergraduates fresh from school He died full of honours and universally respected as a man who consistently maintained the highest standard of public and private duty, and in the midst of responsibilities which might well have absorbed all his attention, was always ready to give his time to the performance of innumerable acts of kindness.

SIDNEY F. HARMER.

WE regret to announce the following deaths:

M Emile Haug, membre titulaire of the Section of Mineralogy of the Paris Academy of Sciences, professor of geology at the Sorbonne and a past president of the Geological Society of France, on Aug. 28, aged sixty-six years.

Prof. L R. Lenox, for thirty-five years a member of the faculty of chemistry at Stanford University,

on July 25, aged sixty-two years.

Dr Thomas W. Salmon, medical director of the US National Committee for Mental Hygiene and professor of psychiatry in Columbia University, New York, on Aug. 13, aged fifty-one years.

Prof. Adrian Stokes, Sir William Dunn professor of pathology in the University of London, while with the Rockefeller expedition investigating West African yellow fever, at Lagos on Sept. 19, aged forty years.

# News and Views.

Manufacturers in Great Britain have been the targets of much deserved criticism on account of their long neglect of the assistance which systematic chemical and physical research is able to offer them, but in recent years their attitude has implied a growing faith. Doubtless their policy in the past has been conditioned more by the fact that research organisations adequate to the study of many of their problems cost a great deal of money than by any hostility to the idea of progress, although this is probably not universally true; 'small profits and quick returns,' however excellent a maxim, does not stimulate the long view when business is brisk, and cannot afford it during a slump. The realisation, however, that industrial competition does not necessarily exclude scientific co-operation has led to the establishment and profitable operation, with State assistance, of a number of research associations. The youngest member of the family is the Research Association of British Paint, Colour, and Varnish Manufacturers, which was incorporated in September 1926, and the laboratories of which were opened at the first annual general meeting at Teddington on Sept. 21

THE new Association, of which the president is Mr. S. K. Thornley and the director is Dr. L. A. Jordan, comes into existence at an interesting, if difficult, stage in the history of paint and varnish making. The ingredients of the good old varnish, often made by a secret process, find themselves challenged by new materials having unchallengeable protective and decorative qualities; the new materials require careful study in a variety of conditions, and the

relation of the character of the protective film to those of the liquid applied are by no means fully understood. It is now realised that the paint or varnish, as manufactured, is, after all, only an intermediate product; its properties are of interest chiefly so far as-subject to the interference of external conditions such as climate and weather—they govern those of the film. Decoration, as well as protection, also moves with the times. The statement that the United States of America is using wood four times as rapidly as it is growing, or that that country wastes thirty million dollars annually on rust and decay, is adequate enough to support the 'more and better paint' movement, but a generally enhanced appreciation of the decorative value of paint coatings, with its demand for new shades of colour, new surfaces, and new properties, cannot be ignored.

CLEARLY, the wide problems of the paint and varnish industries are beyond the resources of single manufacturers. Co-operation, however, has already made possible the equipment for the new research association of three chemical and physical laboratories, with offices and library, and work is now proceeding on the equipment of a workshop and technical laboratory, so that processes can be tested on a semimanufacturing scale. Already several specialised pieces of plant and apparatus have been presented or lent to the Association by firms or individuals interested in its work. Whilst the technical side of the work is in its preliminary stages, laboratory research on several important problems is already in active progress. Economies and profits will doubtless accrue to the promoters from many of the investigations

undertaken, but it must be remembered that a single important property such as the durability of paint may eventually be thereby improved in such a way as to conter benefits on the community and on the individual far greater than can be measured by the financial return to the paint and varnish industry itself. Governments seldom fail to receive their due share of abuse, and politicians are but infrequently immune from accusation of their failure to see, much less appreciate, the scientific point of view, yet much may be forgiven a Department of State which has had Ithe wisdom to encourage, with practical assistance, the policy of co-operative scientific and industrial research, and those various groups of business men who, though times have been bad, have had the foresight to translate the policy into effective action

THE biennial conference of the International Society of Leather Trades' Chemists took place from Sept 12 to 14 at the Leathersellers' Hall, London, and was attended by the president of the Society, Prof D. McCandlish, the Worshipful Master of the Leather-Company, representatives from British sellers' scientific societies and trade organisations, and members of the Society from Great Britain, France, Belgium, Italy, Czecho-Slovakia, Spain, and India. The Conference paid a warm and respectful tribute to the memory of the late Prof. H. R. Procter, the great pioneer of the scientific study of leather manufacture and one of the founders of the Society, and decided in his honour to establish a fund for the endowment of a post-graduate fellowship for research in leather chemistry to be held at the Procter International Research Laboratory at the University of Leeds. The progress of scientific research in the leather industry has constantly been hampered by the difficulty of analysing such complex materials as leather, tanning extracts, and hide, and research in analytical methods inevitably occupies much of the attention of the Society. The methods hitherto recommended by the Society are not trustworthy in their results, and the conference decided to confirm the adoption of the new method for the analysis of tanning materials which was recommended in May last at an international congress of the three societies of leather trades, namely, the International Society, the American Leather Chemists' Association, and the Internationale Vereine der Leder-Industrie Chemiker. This new method has now been adopted by the International and the American societies, and it is believed that the German society is also taking the necessary steps to ensure its adoption by their members.

The basis of the new method which has been recommended by the International Society of Leather Trades' Chemists for the analysis of tanning materials is the use of a hide powder washed free from mineral salts by means of a very weakly acid solution brought to a pH of 5 to 5.4, i.e. to the iso-electric point of collagen. Such powders contain only a trace of mineral matter and give much more uniform results in the analysis of tanning materials than earlier powders, which contained a variable residuum of

calcium salts. The methods of analysis of vegetable and chrome tanned leather and various materials used in the manufacture of leather were also considered at the recent meeting. It was urgently recommended by the Society that the great amount of damage caused by the warble fly should be brought to the notice of the governments of each country represented There are several good specifics against the pest, dichlorbenzoyl in vaseline and a suspension of tobacco powder both having proved effective In Denmark the use of prophylactics had been made compulsory, with the result that the percentage of damaged hides among the indigenous cattle had fallen from 25 to 8 The British Warble Fly Commission, under Prof. Carpenter, abolished warble fly in two years from a small island off the north coast of Ireland. Re-infection of clean areas by imported stock is controlled in Switzerland by the compulsory slaughtering of all imported live cattle within twenty-four hours. In England there are no compulsory measures against warble fly, and live cattle for store purposes enter freely at the ports. It is perhaps not surprising that the percentage of 'warbled' hides among English and Irish cattle is very high.

To the July number of Electrical Communication, Mr. Rollo Appleyard contributes a very interesting article on Charles Wheatstone. Wheatstone is best remembered by electricians in connexion with Wheatstone's bridge, which is used in measuring electrical resistance. Yet curiously enough, Wheatstone himself scrupulously assigns this bridge to its first inventor, S. H. Christie. If it is true that a man is known by his friends, then it is sufficient to mention that Wheatstone was the friend of Faraday, Huxley, Brewster, and Tyndall, all of whom did invaluable work in the cause of science and consequently for the benefit of humanity. With the exception of Brewster, none of these had received what can be called systematic education, but all were enthusiastic research workers Wheatstone, probably more than any other man, developed the practical side of electric telegraphy. No account of a practical electric telegraph was published prior to Cooke's and Wheatstone's patent taken out in 1837. His sine wave model, his kaleidophone, his gas-jet organ, his concertinas, and his polar clock are only a few of his many inventions His rotating mirror verified Kelvin's prediction that in many cases a Leyden jar spark discharge is oscillatory. His endless patience as an experimenter was proved by the many experiments he made to determine the velocity of an electric discharge through a wire. But as J. B. Dumas said, his memory will live not only by his achievements but also by the recollection of "his rare qualities of heart, the uprightness of his character, and the agreeable charm of his personal demeanour."

ONE of Wheatstone's earliest inventions was an instrument he called "the enchanted lyre." It was suspended from the ceiling by a cord and the music appeared to proceed from a combined "harp, pianoforte, and dulcimer." Wheatstone himself described

it as an application of a general principle for conducting sound. A writer in the Repository of Aits for September 1821, when describing this instrument, foreshadows modern broadcasting in a remarkable way. "Who knows but by this means the music of an opera performed at the King's Theatre may ere long be simultaneously enjoyed at Hanover Square Rooms, the City of London Tavern, and even at the Horns Tavern at Kennington, the sound travelling ... from the main laboratory of harmony in the Haymarket to distant parts of the metropolis ... perhaps words of speech may be susceptible of the same means of propagation." In this connexion it is interesting to recall that the ancient Greeks believed that Pythagoras could lecture simultaneously in several towns many miles apart.

In the course of the Congress of the Institut International d'Anthropologie, which was held at Amsterdam on Sept. 20-27, it was announced that the Prix Hollandais of the Institut has been awarded to Miss Dorothy A. E. Garrod in recognition of her work in prehistoric archæology, and especially for her excavation of the cave at the Devil's Tower, Gibraltar, in the course of which she found the second of the two Mousterian Gibraltar skulls, the first having been discovered in 1843. It will be remembered that the site on which Miss Garrod worked was noted by the Abbé Breul during the War, but excavation necessarily had to be postponed. A preliminary account of the fragments of the skull discovered by Miss Garrod earlier in the summer, which had been reconstructed by Mr. Dudley Buxton, was given at the Oxford meeting of the British Association last year. Miss Garrod returned to the site later in the autumn and cleared the cave to bed-rock, discovering further fragments of the skull. The whole, as now reconstructed, apparently that of a child from eight to ten years old, will be exhibited and described shortly at a meeting of the Royal Anthropological Institute. Miss Garrod is also the author of a valuable survey of the evidence relating to early man from the caves in Britain entitled "The Upper Palæolithic Age in Britain." We offer our sincere congratulations to Miss Garrod on her well-deserved honour.

Mr. C. F. Talman, librarian of the United States Weather Bureau, is writing articles on weather topics every day for Science Service of Washington. These are appearing in the Boston Transcript and ten other North American newspapers. The uniquely favourable position of Mr. Talman for work of this kind is evident after a perusal of one of these articles, which gives an account of the library under his charge at Washington. This library contains about 46,000 volumes, and is said to be the largest of its kind in existence; it includes a vast number of books about the weather and climate of all parts of the globe, in addition to all treatises on meteorology that have appeared anywhere in the world, so far as the U.S. Weather Bureau has been able to secure them. With this mine of information immediately to hand, Mr. Talman no doubt has little

difficulty in finding some item of interest for each day of the year; he has, moreover, the gift of being both lucid and entertaining.

THE range of subjects dealt with by Mr. Talman in a sample batch of articles received recently, covering the period May 2 to Aug. 18, 1927, occasionally extends into the borderland of meteorology, e.g., "Experiments with Icebergs"—an account of attempts to destroy icebergs with the aid of ignited charges of thermit—"The Dust we Breathe," "Mysterious Sounds that Haunt the Air," "Will o' the Wisp," and so on Care has been taken to choose, so far as possible, subjects likely to be topical at the time of their publication, which is of necessity a week or so later than the time when they are completed; thus for May 11 an article on "The Traditional Cold Spell in May" was chosen, while several articles on very hot weather, and the best means of avoiding its attendant discomforts, were timed to appear in that portion of July that has the highest mean temperature. It is satisfactory to find no evidence anywhere in the series under review of a sacrifice of accuracy to interest. The articles must stimulate thought and should tend to dispel many absurd illusions about the weather that are still current

THE Registrar-General's Statistical Review, 1926, Tables, Part 2, has recently been issued by H.M. Stationery Office (price 5s.). Among the wealth of material it contains, the following points are of wide interest. The total population in thousands of Great Britain and Ireland was:

	1926	1925	Increase+ or Decrease- per cent
England and Wales.	39,067	38,890	+0.46
Scotland	4,897	4,893	+0.08
Northern Ireland .	1,256	1,257	- 0 08
Irish Free State .	2,970	2,985	- 0 50
Total	48,190	48,025	+0.34

In England and Wales the male population increased by 0.52 per cent. and the female population by 0.40 per cent. The births registered during the year 1926 numbered 694,563, which is equal to a rate of 17.8 per 1000 population. This rate was 0.5 per 1000 below that recorded in the previous year and, with the exception of the War year 1918, is the lowest rate recorded since the establishment of civil registration. Not only has the birth rate declined but also the actual number of births is the lowest recorded since 1860, when the population of England and Wales was only 19,902,000, or about one-half of the estimate for 1926. The number of illegitimate births was 29,591, or 43 per 1000 total births, and was 695 in excess of the total recorded in the previous year. The proportion of male to 1000 female births was 1041. This proportion showed a great increase during the War years and reached a maximum of 1060 in 1919, since when the decline has been almost continuous, and the rate is now approximating to that which prevailed in the period immediately prior to the War.

LATE on the night of Sept 24, the R R.S. *Discovery* anchored in Falmouth Harbour, having completed a two years' cruise to Cape Town, South Georgia, and

the Falkland Islands, she is expected to arrive in the Thames on Oct 1 It will be remembered that the primary object in fitting out the Discovery expedition was the investigation of the southern whaling fisheries, and a report of the work carried out up to August 1926 was contributed by the Director of Research, Dr Stanley Kemp, and members of the scientific staff, to our issue of Oct 30, 1926. p. 628 The first annual report of the expedition, bringing the account up to the end of 1926, has been recently published (see NATURE, Aug. 27, p 308) It is expected that the scientific staff will spend some months ashore working up the results of the expedition, and it is confidently expected that these will prove of great value to science and to the whaling industry

A new speed record was set up near Venice by Flight-Lieutenant S. N. Webster when he won the race for the Schneider Cup for Great Britain on Sept. 26 at an average speed of 281 miles 1246 yards an hour The race was over a course about 31 miles in length and triangular in shape, and seven laps had to be covered; this meant making two sharp turns in each lap. Three Italian and three British machines started, but the Italian pilots and one of the British pilots had to come down Lieut. Webster was flying a Supermarine-Napier S5 with geared engine. This engine, a development of the Napier Lion unit, weighs 920 lb. and develops 890 hp The Supermarine seaplane was designed by Mr. R J. Mitchell, who seems to have been most successful in devising means for reducing head resistance; for example, petrol was stored in one of the floats, while the radiator for the water-cooling system was fitted in an improved way beneath one of the wings. The only other machine which completed the course, piloted by Flight-Lieut O. E. Worsley, was also a Supermarine Napier, but with an ungeared engine Lieut. Worsley's average speed was 2736 miles an hour. In last year's race for the Schneider Cup, the winner, Major de Bernardi (Italy), on a Macchi monoplane with 800 h.p. Fiat engine, averaged 2465 miles an hour. This year, for the first time, the British entry was organised entirely by the Air Ministry and service pilots were trained for the race

To ascertain the value of aerial photography in the revision of 1/2500 Ordnance Survey plans, an area of some fifty square miles near Eastbourne was photographed from the air at the same time that the usual revision was taking place during the summer of 1925. The results of this experiment are given in a small pamphlet issued by the Ordnance Survey and entitled "Report on the Experimental Revision of the 1/2500 Ordnance Survey Plans with the aid of Photographs taken from the Air" (London: H.M. Stationery Office. 4d. net). It was found that this method was 50 per cent. quicker than field work, 1670 square miles being photographed by one machine in less than one hundred days. With the exception of some types of wire fences, all details were easily identified in the photographs, and changes in features could be plotted with accuracy. Invasion of lands and premises is reduced by the new method, and the interval between

revision and publication should be shorter than it was of old. The high costs of aerial ievision could no doubt be substantially reduced, but the speed of the work makes it impossible to offer a continuous programme of flying to the aviators As a result of the experiment, the Ordnance Survey proposes to revise solely by aerial photography an area of about 100 square miles each year for several years. It will then be possible to decide if the method will be economical to adopt for all large-scale revisions.

WITH the object of collecting, correlating, and placing at the disposal of British industry, all information of a technical and practical character with regard to the use of nickel and its alloys, the Bureau of Information on Nickel, Limited, has been established with offices at 2 Metal Exchange Buildings, Leadenhall Avenue, London, EC.3. The services of the Bureau will be rendered without charge or condition

SIR ARTHUR KEITH'S recent presidential address to the British Association is to be published in Messrs. Watts and Co.'s Forum Series. It will contain a foreword and a supplementary paper entitled "Further Evidence and Some Unsolved Problems"; and there will also be included three essays on "Darwin's Home," "Why I am a Darwinist," and "Capital as a Factor in Evolution," as well as a page diagram elucidating man's origin. The price of the publication will be 7d.

Applications are invited for the following appointments, on or before the dates mentioned :-- A lecturer in engineering subjects at the Technical College, East London, South Africa—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C 2 (Oct. 7). A woman professor of physiology at the Lady Hardinge Medical College, Delhi—The Honorary Secretary, U.K. Branch Dufferm Fund, care of Major-General J. B. Smith, India Office, Whitehall, S.W.1 (Oct. 8). An agricultural economist and an agricultural engineer under the agricultural department of the Tasmanian Government — The Agent-General for Tasmania, Australia House, Strand, W C.2 (Oct. 14). A county education officer for the Administrative County of Southampton—The Clerk of the County Council, The Castle, Winchester (Oct. 17). An entomologist in the veterinary department of Tanganyıka Territory with special knowledge of the blood-sucking diptera and the Ixodidæ-The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1 (Nov. 15). A senior lecturer in geography and geology at the Natal University College, Pietermaritzburg—The Registrar, Natal University College, Pietermaritzburg, Natal (Nov. 30). A woman graduate as chief assistant in the Domestic Science Department of the Battersea Polytechnic—The Principal, Battersea Polytechnic, S.W.11. assistant bacteriologist at the Wellcome Research Laboratories, Khartoum—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, S.W.1. A test assistant at the Aeroplane and Armament Experimental Establishment of the Air Ministry, Martlesham Heath-The Officer Commanding, Aeroplane and Armament Experimental Establishment, Martlesham Heath. Woodbridge, Suffolk An evening lecturer in structural mechanics at the West Ham Municipal College—The Principal, Municipal College, Romford Road, Stratford, E.15

THE Royal Commission appointed by the Commonwealth Government to inquire into the control and development of radio severely criticises Amalgamated Wireless (Australasia), Limited. This Company claims to have many patents, embracing all branches of radio communication. According to a report in the Times of Sept 15, the Commission says that the Company's demand for royalties is based on the principle "that it is entitled to obtain from the public whatever it can get." The Commission urges that the Company should make reductions in the charges for the use of patents If the Company fails to make the suggested reductions, the Com-

mission urges that the Commonwealth Government, after ascertaining that the patents are valid, should purchase all the privately held shares in the company and so acquire complete control Without a full knowledge of the facts, it is very difficult to criticise the motives and actions of the Commission and of Amalgamated Wireless (Australasia), Limited. The Government of Australia holds the majority of the shares, and we should have expected them to control the actions of the Amalgamated Company companies which have expended considerable sums in research for many years hope to reap a harvest later on. It is in the public interest that they should receive royalties on their patents at least for a period of years. It is in this way that great industries have been built up. We believe that there are between two and three thousand companies in Great Britain which utilise broadcasting patents. There seems to be no attempt to create a monopoly for a few favoured firms. The question seems one that could be quickly settled by arbitration

### Our Astronomical Column.

ROTATION OF THE GALAXY -The fact that the spectroscope reveals rotation in several spiral nebulæ renders it not improbable that a similar motion may be present in the galaxy, which has many points of resemblance to the spirals; it is not very easy, however, to detect a small systematic effect of this kind from star observations. Mr J. H. Oort makes the attempt in Bull Astr Inst Neth., No. 132 He makes the assumption that there is unlikely to be any systematic motion at right angles to the galaxy; he therefore deduces the precession from proper motions resolved in that direction and finds a correction to Newcomb's precession of 1".37 per century and a rotational effect of about 1" per century.

Mr. Oort notes that if all the mass of the galaxy were concentrated at the centre, the law of force would be the inverse square of the distance; while if the mass were distributed uniformly through a sphere, the law within the sphere would be the direct distance; the actual law would be between the two. He deduces tentatively that the force according to the inverse square law is 6/10 of the whole, from which he finds that the central mass is about sixty thousand

million times that of the sun.

The linear speed of rotation in the sun's neighbourhood is found to be 286 km./sec. towards galactic longitude 55°. The author suggests that the radial velocities found for the Magellanic Clouds is accounted for by this rotational motion, so that they may be outlying portions of the galaxy.

THE NEW STAR IN AQUILA.—Astr. Nach., No. 5519, contains details of the spectrum of this star as photographed at Konigstuhl by Prof Max Wolf on Aug. 17. These agree well with the usual nova type. The hydrogen lines  $H\beta$  to  $H\eta$  were seen both as emission and absorption lines; the absorption lines indicated a radial motion of  $-1600~\rm{km}$  /sec., while the emission ones indicated +100 to +150 km./sec.

THE TOTAL SOLAR ECLIPSE OF JUNE 29.—Astr. Nach, No. 5519, contains observations of the total solar eclipse made at Ringebu, Norway, by G. Armellini and G. Conti of the Campidoglio Observatory, Rome. Shadow bands were well seen both before

and after totality, the latter being the stronger. They were curved like the letter S and had an undulatory movement. The illumination during totality was much greater than that of the full moon. Signor Armellini could read type 0.5 mm. high, while 2 mm. was the minimum in full moonlight. Most of the light during totality was diffused skylight, not that of the corona, as was shown by the fact that a stick 4 cm. in diameter threw no perceptible shadow on a white sheet. The observed times of beginning and end of totality were 5h 34m 50 3s, and 5h 35m 24.6s, U.T., each about \frac{1}{2} sec. earlier than calculation.

A sketch by Signor Conti shows the corona as a uniform ring some 7' high, with seven long rays at fairly equal intervals. The longest are 40' long. The temperature fell from 11°·1 C. to 7° 9 C., afterwards rising to 12°·4 C. The colour of the prominences is described as reddish-violet and as yellowish-red by

the two observers respectively.

NORMAN LOCKYER OBSERVATORY.—The annual report of the director of the Norman Lockyer Observatory, which has recently appeared, shows a continuance of the programme which has been so usefully followed during the last few years. The chief features are the photography of stellar spectra for classification and parallax work, and the detailed study of changes in the spectra of bright line stars of early type. Four papers dealing with this work have been published during the year, and three others are in preparation. In addition, the 51-inch doublet has been mounted for the photography of meteors, and has been oriented to the pole star on clear nights when there has been no bright moonlight. Arrangements were made for obtaining large-scale photographs of the chromosphere, prominences, and corona, and small-scale photographs of the corona and its spectrum, at Richmond (Yorks.) during the total solar eclipse of June 29 last; while at the observatory at Sidmouth, preparations were made for securing large-scale spectra of the chromosphere with the Hilger Littrow spectrograph. Neither programme, however, could be carried out, owing to unfavourable weather. The accounts for the year show a loss of £227, and the hope is expressed that further endowments will be forthcoming.

# Research Items.

Chinese Gongs.—Major E. C. Kenny, in Man for September, describes the two types of rare 'Chinese gongs' which are found in Burma, and usually called by the English residents there 'Karen War Drums.' They are now only found in the little frontier State of Karenni. The gongs are of two types, and of these the taller and more modern were made up to a time so recent as 1894 by the Shan for their overlords the Karen. The flatter ancient type is beyond doubt of Chinese origin, and is very rare. The Karen assert that these latter were not made by human agency at all, but by spirits, who are said to assume the forms of beautiful maidens and to sing sweetly in the jungle on the outskirts of villages, attracting youths whom they destroy. One gong of this type in the British Museum is dated 'Made by Chang Fu in the 7 month of the 4 year of the reign of Chien Hsing," ie a document to whether they are decorated or not, the latter being the male, and are frequently found in pairs. The drums are used for crop and other festivals, and periodically for summoning the outlying villages, but apparently never for war.

THE STONE BATTLE-AXE.—The spread of the stone or copper battle-axe is discussed by Prof. H. J. Fleure and Mr. Harold Peake in a communication in Man for September. They take the view that the axe-hammer with a shaft-hole was probably first made in metal and that the oldest example published is that from Cemetery A at Kish, dated at 3100-3000 BC., although older examples have recently come from Ur. Although it may seem a far cry from Mesopotamia to a European centre, the connexion between early Kuban and the Cyclades has been demonstrated, while the former has too many elements of kinship with Mesopotamia to leave any doubt of their common origin. It is suggested that it was through the Cycladic contact with Kuban that the battle-axe entered Cycladic Minoan culture in Early Minoan II The early metal axe of copper had the butt end bent round to form the shaft-hole, and the earliest cast specimens had the hole nearer one end. When copied in stone the axe would have one cutting-edge with the shaft toward the butt end, though not so near as in the metal type, to avoid splitting. It has been argued that of the British perforated axes, those with the hole nearer one end are earlier than those in which it is situated centrally. It is agreed that in the Baltic area the stone battleaxe underwent great development, but even here a copper axe from Norway would serve as a metal prototype. The authors' view is that in the Baltic area the only culture was that of the shell mounds until the Megalithic culture impinged on it from the south-west and the culture of the battle-axe and fine flint work came from the south-east.

International Herring Investigations.—Rapports et Procès-verbaux des Réunions, vol. 41, of the Conseil Perm. Internat. pour l'Expl. de la Mer, contains a good deal of information concerning the present state of our knowledge of the herrings in the North Sea, and sets out the programmes of investigations which are being undertaken by the countries interested. The immense value of continuous observation over an extended period is admirably demonstrated by the striking results achieved by the Norwegian investigators through an unbroken series of years from 1907 to the present time. Mr. Einer Lea's preliminary report on these results, and his discussion on the most

satisfactory method of summarising the observations for one season so as to give the best possible representation of the age-composition of the stock, will be read with interest. The report on Scottish investigations regarding the larval and post-larval stages of herring in the northern North Sea not only indicates the immediate difficulties experienced, but also demonstrates the general fact that great caution must be exercised when estimating age from scales of adult Evidence is advanced that some of the Scottish post-larvæ acquire scales during the calendar year in which they are born, so that their first winter of life is recorded on the scale as a winter-ring. Others, however, remain in the unscaled condition until the year following birth, the first winter-ring not being formed on the scale until the second winter of life. This fact very materially adds to the difficulty of estimating the age and origin of the adult fishes which visit Scottish waters.

FISH EGGS AND LARVÆ FROM THE JAVA SEA.-In vol. 8 and vol. 9 (1926) of De Treubia, Dr. H C. Delsman gives a detailed account of his studies of fish eggs and larvæ from the Java Sea. His observations of the time of the day at which spawning appears to occur, and of the length of the incubation period of some of the eggs, are particularly interesting. Thus, the eggs of three species of the genus Caranx are all set free at a definite time towards midnight. 9 A.M. on the following morning, that is, less than 12 hours after, those of C. macrosoma hatch out Between 11 A.M. and 1 P.M. those of C. kurra hatch, while at 6 P.M. the young of C. crumenophthalmus emerge. In the course of egg-sampling with townets, therefore, the eggs of C. macrosoma are to be found only in early morning hauls; those of C. kurra disappear from the tow-nets at about 1 P.M., so that in the afternoon only those of C. crumenophthalmus These results are in accordance with a general rule that larger, more yolk-laden eggs take a longer time for their development than smaller ones with less yolk. Equally striking is the author's account of the growth of the embryo assigned to Clupea fimbriata. Eggs taken at 7 AM. showed only a small germinal disc and had evidently been laid shortly before capture. At 8 45 A.M. the germinal disc had grown half round the circumference of the egg, and the first indication of the embryo had appeared. At 10.45 A.M. the blastopore closed and the rudiment of the embryo had grown more distinct. During the afternoon the tail grew out, the embryo began to 'sprawl' within the spacious egg-membrane, and at 6 P.M. it hatched. Some idea of the speedingup of the incubation period can be gathered from the comparison between the hatching of Scomber kanagurta in less than 24 hours, and that of the mackerel Scomber scomber) in 6 days in British waters, or with the 5 days for the American mackerel.

Japanese Freshwater Branchiofoda.—M Ueno (Mem. Coll. Sci. Kyoto Imp Univ., B, vol. 2, No. 5, art. 12, 1926) gives a list and some details of the genera, species, and varieties of freshwater branchiofoda hitherto found in Japan, together with a few records from eastern China Of the thirty-one species of Cladocera, twenty-five are found also in Europe, but the Japanese Phyllopoda belong to species not represented in Europe. The author is inclined to believe that Japanese examples of the Cladocera are generally smaller in size than corresponding specimens from Europe or America, but he adds that further study is required before this can be decided.

GROWTH OF PARAMECIUM -F. Mizuno has made careful observations (Science Reports, Töhuku Imp Univ, 4th series, vol. 2, No. 4, 1927) on the normal growth of Paramæcium caudatum. He found that at a temperature of 24°-26° C, division occurs at the end of eight or nine hours and that there was no difference in the rate of division between examples in light and others in the dark. More than 600 specimens were killed at definite intervals after fission had occurred and they were drawn, their length and breadth measured, and their area determined by a planimeter. Immediately after fission, the daughter Paramecia increase markedly in length but decrease in breadth; that is, there is a change in their form. Size cannot therefore be estimated by measuring only the length, and as the volume could not be accurately ascertained, the most satisfactory method appeared to be the careful determination of the area. When the areas of specimens killed at known times after fission are plotted, they show that the growth of Paramecium is represented by a linear curve.

LENS DESIGN -In Scientific Paper of the Bureau of Standards, No. 550, Mr. I. C. Gardnei deals with the application of the third order algebraic aberration equations for a thin lens to the design of lenses to fulfil given conditions. Up to the present, there has been no book giving the third order aberrations in a form quite satisfactory for this purpose, and it has been difficult for a designer to get any information between that given in elementary text-books and that to be found in works on instrument design and other specialised problems. The notation adopted is substantially that of von Rohr, but by the intro-duction of a modification in that of Taylor, it has been possible to give the results in each of the two notations. The sign of the distance of a point from the lens is positive if in moving with the incident light one passes through the lens before reaching the point Designs of thin lenses and of systems contaming thin lenses and prisms are worked out in detail by the author, and the paper of 130 pages should be of great help to the optical designer.

Molecular Volumes at Absolute Zero.—In two interesting papers in the August number of the Journal of the Chemical Society, S. Sugden has shown that the simple equation  $D-d=D_o(1-T_r)^{3/10}$  applies with great accuracy to Young's results for the liquid and vapour densities of thirty substances.  $D_r$ , d are the densities of liquid and saturated vapour,  $D_o$  is the density at the absolute zero,  $T_r$  is the reduced temperature. The equation contains two constants,  $D_o$  and the critical temperature, only. It is therefore possible to calculate  $M'D_o$ , the molecular volume at the absolute zero. This magnitude,  $V_o$ , is shown empirically to be a nearly constant fraction, the values ranging from 0.264 to 0.280, for a number of substances. The value for hydrogen in 0.373. The equation proposed by Sugden is a special case of a general one proposed by Verschaffelt, but the constants chosen give better results. The results apply also to associated liquids. It is further shown that values of  $V_o$  can be predicted by adding together certain characteristic constants for the atoms and structures present in the molecule for a very large number of compounds.

RETURN CIRCUITS IN ELECTRIC TRAMWAYS.—In electric tramway systems, for the sake of economy, it is customary to use the rails as part of the circuit connecting the dynamos at the tramway power station with the motors on the car. These rails are connected through the tram wheels with the negative

poles of the dynamos, and as they have to large current, an appreciable difference of pc exists between various points on their lengths they are not insulated, only part of the return curred flows by the rails, the rest flowing through the earth. the pipes of water and gas companies, and the coverings of telephone cables. The possibilities of serious electrolytic corrosion in large telephone cables by these leakage or 'vagabond' currents has made traction engineers consider whether the present precautions are sufficient In World Power for September, G. W Stubbings gives a helpful contribution to the subject. The Ministry of Transport has imposed the regulation that the difference of potential between any two points on the rails must not exceed 7 volts. This regulation has been in use for many years and so tai has been found quite satisfactory. The replacement of overhead telephone wires by underground cables is a new fact that has to be considered. When the current flows from the cable sheath to the rails there are risks of serious erosion occurring. A further restriction has been imposed, that the maximum potential difference between the rails and a buried pipe in its vicinity shall not exceed 1 5 volts when the rail is negative to the pipe and 45 volts when the rail is positive to the pipe. This restriction seems desirable, but to apply it equitably in practice is difficult. In Great Britain, traction engineers as a rule rely on maintaining the potentials of the rails low by means of special dynamos taking current from definite points of the rails through insulated circuits Mr Stubbings considers the relative merits of this method and that of using special copper conductors. Many interesting mathematical problems arise

ELECTRIC MOMENTS OF ORGANIC MOLECULES IN Benzene Solution.—Measurements of the dielectric constants of binary systems in which the first component (eg. benzene) is known to have no electric moment allow of the calculation of the electric moment of the molecule of the second component. The equation used is a combination of the familiar Clausius-Mosotti law with a result deduced by Debye, in which the molar polarisation is shown to be a linear function of the reciprocal of the absolute temperature. In the July number of the Journal of the American Chemical Society, J. W. Williams and I J. Krchma apply this formula to the results found with a number of solutions in benzene. The values for the electric moments of the solute molecules vary from zero for carbon tetrachloride to  $1.70 \times 10^{-18}$  for phenol; ethyl ether has the value 122 10-18, chloroform 1  $10 \times 10^{-18}$ , and chlorobenzene  $1.55 \times 10^{-18}$ . These are in good agreement with previous results with the pure substances. These results are clearly of importance in certain fields of speculation in organic chemistry. An interesting result is that the moment of symmetrical xylene is very small, whilst it is appreciable in the case of unsymmetrical xylene.

The Supposed Phosphorus Suboxide,  $P_2O$ .— From time to time various lower oxides of phosphorus have been described, but most of these have been shown to be impure amorphous phosphorus. One of them, Besson's oxide,  $P_2O$ , has been investigated by Chalk and Partington, whose results are described in the August number of the Journal of the Chemical Society. It is shown that the supposed oxide is again an impure form of amorphous phosphorous, contaminated with the materials used in the preparation described by Besson. The existence of an oxide of phosphorus below  $P_4O_6$  should therefore still be regarded as extremely doubtful.

# The International Union of Geodesy and Geophysics.

HE third conference of the International Union of Geodesy and Geophysics was held at Prague on Sept. 3-10. at the invitation of the Czechoslovakian Government, though most of the sections found it necessary to hold some of their meetings in the preceding week in order to get through their programmes of work. Previous meetings held at Rome in 1922, and at Madrid in 1924, had proved to be of great value in providing an opportunity for workers in a group of sciences where international co-operation is essential to discuss methods and to arrange schemes for future work.

On the present occasion, 29 out of the 32 countries belonging to the Union were represented by delegates, who numbered more than 160. The Union, with its sections for geodesy, seismology, meteorology, terrestrial magnetism and electricity, oceanography, volcanology, and hydrology, covers a very wide field, and these triennial meetings afford an occasion when questions involving two or more of these fields of work can be discussed by those who are actually

occupied with them.

In the Section of Geodesy the determinations of gravity at sea, made by Dr. Vening Meinesz of Holland on board a submarine during a voyage to Port Said, and also during one to Java by way of the Panama Canal, were described by him, and aroused much interest. The great ocean areas were shown to be generally in a state of approximate isostatic equilibrium, except in places where crustal movement is in progress, such as the Straits of Sunda, where considerable anomalies were shown to exist. The conference expressed the hope that other nations having submarines of a suitable type will co-operate in this work of gravity determination over ocean areas now that a satisfactory method of doing so has been developed, and proved to be efficient. Dr. Vening Memesz also described certain improvements in his pendulum apparatus which he had introduced as the result of his experiences on submarine cruises. Detailed accounts of this work will be published by the Dutch Geodetic Commission.

The geodetic work which has been carried out recently on a co-operative plan by the countries on the shores of the Baltic furnished an example of an excellent piece of work, well designed and carefully carried out. It was suggested that such work might be done usefully in other restricted areas by similar co-operation. Summaries of geodetic work carried out since the last conference were communicated by many countries, and were thus made available to other geodesists much sooner than would otherwise

have been the case.

In seismology much useful work was done in the discussion of the analysis of seismograms, the improvement of telegraphic codes, the preparation of tables for use in the reduction of seismological data, etc. The conference urged that the countries concerned should improve the network of existing stations by establishing additional ones in North Spain, in the Balearic Islands, and in New Caledonia or Tahiti. A proposal of the National Committee for the United States that countries should co-operate in the study of ocean deeps was strongly supported.

The Section of Meteorology was occupied with a large number of scientific questions, among which the preparation of daily synoptic charts of the South Pacific Ocean, the extended study of solar radiation, and upper air observations in tropical regions and in the southern hemisphere, may be mentioned. The conference adopted a recommendation of the Section expressing the hope that this investigation of the

upper air in low and southern latitudes might be actively prosecuted. Now that the International Meteorological Committee finds itself very fully occupied with matters relating to the working of the meteorological services of the various countries, this Section of the Geodetic and Geophysical Union finds full employment in the discussion of many scientific matters which would probably not be dealt with by the Committee; thus, each of the two organisations work without duplicating the work of the other, but on the contrary supplementing it.

on the contrary supplementing it.

The Section of Terrestrial Magnetism had a full programme of work which included the discussion of recent work, the comparison of instruments, the design of improved apparatus, and the reduction of observations. Atmospheric ionisation and the observation of aurora also came under consideration, as well as the need for additional earth-current in-

stallations

The Section of Oceanography did much of its work by sub-committees appointed to consider the investigation of the different great sea areas, and of

tidal phenomena.

In volcanology full accounts were communicated of the recent outburst of Vesuvius, and also of the somewhat earlier volcanic activity at the island of Santorin. Certain problems connected with the transmission of waves in the earth's crust were discussed in a joint meeting with the Section of Seismology, and the thermal gradient in the crust came up for detailed consideration. The conference adopted a resolution by the Section that countries in which active volcanoes occur should be invited to undertake the measurement of the thermal gradient in various localities.

In hydrology much work was done on problems relating to the flow of water, and the transport of silt in suspension also came under discussion. By an arrangement with the International Committee on Glaciers, which was established in 1894, its work will now be transferred to and carried on by a committee of the Section of Hydrology, of which committee M. Hamberg will be the chairman and M. Mercanton the

secretary.

M. Lallemand was re-elected president of the Union up to the end of 1931, when the statutes may be revised and re-approved by the countries of the Union. He will thus have been president throughout the whole of the first period of the Union's activity, twelve years. Some changes were made in the officers of the sections, Dr. L. A. Bauer replacing Dr. C. Chree as president of the Section of Terrestrial Magnetism, and being in turn replaced as secretary by M. Ch. Maurain. M. Wehrlé becomes secretary of the Section of Meteorology.

logy.

The various communications which were made to the sections at their meetings will be published by them in the immediate future, in continuation of the publication series which each section has already

ınıtıated

The most generous hospitality was shown to the delegates both by the Czechoslovakian Government and by the municipality of the city of Prague. In addition, the members of the organising committee made excellent arrangements, by which the delegates were shown all the scientific institutions of importance as well as the numerous museums, galleries, and houses of historical and artistic interest in and near the city.

The President of the Republic was to have received the delegates on one evening, but unfortunately his health did not allow him to return to Prague to do so; the Minister of Foreign Affairs held the reception on his behalf.

On the conclusion of the conference delegates had the choice of visiting the Tatra Mountains in southeastern Czechoslovakia, or the principal health resorts, including Joachimstal, Keilberg, Karlsbad, and Marienbad.

For the next meeting the conference received in-

vitations to meet at Stockholm and at Lisbon; both were accepted in principle, but it was left to the executive committee to decide later which of the two should be definitely accepted, since the wish had been expressed by the United States Research Council that the Union's meeting should take place near in time and place to that of the International Astronomical Union, whenever this should be practicable.

# International Congress of Genetics.

THE fifth International Congress of Genetics, held m Berlin on Sept 11-18, was a very important and successful meeting. The opening addresses of welcome were given in the auditorium of the Berlin Medical Society in Luisenstrasse, while all the other sessions were held at the University (Unter den Linden) Members of the Congress were welcomed by Prof. E. Baur, chairman of the committee of arrangements, as well as by the German Minister of the Interior, the Prussian Minister of Agriculture, the head of the Berlin Medical Service, and Prof. Kniep, representing the University of Berlin. At this meeting an address was given by Prof. R. von Wettstein on the problem of evolution. Prof. S. Navashin, the distinguished cytologist of Moscow, was elected president of the Congress, a fact which is significant of the fundamental part which cytology has played in the modern development of genetics. The membership of the Congress numbered more than Mornings were devoted to general addresses, while in the afternoon the Congress met in six sections and about 135 papers were read.

The sections devoted to general genetics, cytology, and cultivated plants were particularly strong. The largest number of papers were devoted to wheat, maize, Drosophila and Enothera, as many as ten investigators of Enothera being present. A number of papers were concerned with the subject of mutation; several were concerned with the statistics of inheritance, and several with crossing-over. A double attack on the theory of crossing-over led to an extensive and lively discussion in which the great strength of the theory was brought out. In this connexion an important paper by Prof. F. Bernstein pointed out new mathematical relationships which follow from the mechanical theory of crossing-over.

The address of Prof. H. J. Muller, of Texas, on the production of mutations in Drosophila by treatment with X-rays, was generally regarded as the most important contribution to the Congress. Mutations were produced in large numbers by subjecting males or females to X-rays for different periods. Four periods were used, and with the longest period of treatment the rate of mutation was 150 times that in the controls. Genes were affected equally throughout the chromatin and an increase in the X-ray dosage was found to increase the rate of 'point' mutations. Sperm used in fertilisation 6 days or 12 days after treatment showed no difference in the rate of mutation-production. The presence of large numbers of mutations was also found to have little or no effect on sperm viability.

In the X-chromosome of Drosophila, mutations normally appear at the rate of not more than I in 1000. In these experiments many more mutations appeared in the X-chromosome than have occurred in it naturally in all previous experiments. Such well-known mutations as rudimentary wing, broad wing, cross-veinless, white eye, and vermilion eye appeared repeatedly, but there was an enormous increase in the number of lethal factors. It was also found that the effect of X-rays on the ovaries per-

sisted after treatment, a fact which has an important bearing on some of the present methods of X-ray therapy. X-rays also increased the number of c-factors, which reduce the frequency of crossing-over. Rearrangements of loci were also found to occur in the chromosomes. From various experiments the conclusion is reached that the gene is probably compound in the chromosome, composed of 2 or 4 parts, in preparation for later cell divisions. The great majority of the mutations produced are lethal or otherwise invisible, their presence being proved by later breeding experiments

In the genetic work on Enothera, the greatest interest centred around the linkages between chromosomes, which were demonstrated by Cleland and Gates. Each species and mutation is found to have a fixed arrangement of its chromosomes during diakinesis and on the heterotypic spindle. In some wild species all the chromosomes are linked into a ring of 14, while in others there are 7 free pairs. Still other species, such as E. lamarckiana and E. ammophila, have 1 free pair and a ring of 12. In the mutations from E. lamarckiana the arrangement is also a definite one, E. rubrinerus and E. rubricalyx, for example, having 4 free pairs with a ring of 6 chromosomes, while E. deserens has 7 free pairs.

This constitutes essentially a new type of nuclear differentiation. It appears that it will also be of fundamental importance as furnishing the basis for the unique phenomena of linkage of characters into complexes in Enothera, which has not hitherto received an explanation. It is already indicated that where a large amount of chromosome linkage occurs there will be only two (twin) or three hybrid types, while in crosses between forms with many free pairs of chromosomes much segregation will occur. Shull described a new gene mutation from E. lamarckiana, a simple Mendelian recessive showing linkage of the ordinary type.

Among the studies of cereals, Dr. C. L. Huskins showed the existence of speltoid and dwarf wheats having respectively 41, 42, 43, and 44 chromosomes, parallel to the fatuoid series which he has recently discovered in oats. He also described a fatuoid chimæra in oats, and this appears to complete the parallelism in the behaviour of fatuoid oats and speltoid wheat.

Dr. M. Navashn made an important demonstration of the nuclear differences in species and hybrids of Creps. Some of the species differ in the presence of a satellite or a terminal 'head' to the chromosome, and in the hybrids it is shown that the former may be transformed into the latter. This is the first time that a definite change in the structure of a chromosome as the result of hybridisation has been shown. The study of this type of chromosome differentiation is in its infancy and will lead to large results.

Among general addresses to the Congress may be mentioned that of Prof. O. Rosenberg, of Stockholm, on species-formation with multiplication of chromosomes, and Prof. H. Federley, of Helsingfors, on the

chromosome relationships in hybrids. Owing to illness, Prof. C. Correns was unable to give his address on non-Mendelian inheritance, but addresses were given by Dr. Vavilov on the geographical gene-centres of cultivated plants, and by Dr. Blakeslee on the genetics of Datura. Dr. Crew, of Edinburgh, discussed the organisation and function of an animalbreeding research station.

Miss Pellew and Miss de Winton discussed recent work with the garden pea and with Primula sinensis Many other subjects of special interest came before the Congress. Practically every phase of genetical fact and theory was represented, from the study of variegation, clones, and inbreeding to species-crosses, the geographical distribution of genes, and such evolutionary topics as convergence, the unpacking theory of Bateson, and a statistical study of fossil

Ammonites.

In the section on human genetics there were several papers on twins and on the blood groups. Prof. van Bemmelen described the inheritance of curly hair as an apparently simple dominant through several generations. Other papers considered the inheritance of shortsightedness, musical ability, general ability, sex, and psychological peculiarities as well as interracial inheritance in man. In the smaller section of eugenics a number of less strictly genetical questions were discussed.

The excursions formed an important part of the meeting. A ladies committee arranged numerous excursions to places of interest, and a visit to Wannsee and Potsdam was largely attended. But most valuable was the visit to Prof. Baur's Institut fur Vererbungswissenschaft, where his extensive experiments with Antirrhinum were demonstrated, and to the laboratories of Profs Correns, Goldschmidt, Hartmann, Nachtsheim, and others at the Kaiser Wilhelm Institute in Dahlem There were also excursions to Petkus and Ruhlsdorf to study pigbreeding

A reception and dinner was given in the Rathaus by the Municipal Government of Beilin, and the Congress closed with a dinner in the Zoologischer Garten on Sept. 17. This was followed, however, by short visits to horticultural institutions and a four-day excursion to Quedlinburg, Halle, Weimar, and other places, where various plant and animal-

breeding establishments were inspected.

The Proceedings of the Congress are to be published promptly and will constitute a valuable survey of the present problems in genetics. The next Congress is to be held in America in 1932—under the presidency of Prof T. H. Morgan. The present Congress, which was the first since the 1911 meeting in Paris, has served to show the fundamental part which cytology has played in the development of genetics during the last fifteen years. It is safe to say that no complicated genetic problem can now be solved without the aid of cytological research, and nearly all the most important recent developments of the subject have had a cytological basis. This mutual support of cytology and genetics is one of the most promising features for the future of genetics.

R. Ruggles Gates.

# Conference on Adult Education.

CENTURY ago the Mechanics' Institutes were developing among artisans a new enthusiasm for study of the sciences instrumental in bringing about the industrial revolution. One of the marked defects in adult education nowadays is the neglect of science, though here and there a class in biology or some related subject may be found. It is the more cheering, therefore, to learn that the British Institute of Adult Education not only devoted its recent Conference, held at Balliol College, Oxford, on Sept. 23-26, to discussion of this situation, but also can report a singularly interesting and useful series of meetings. The Institute had previously sent to each of those present a copy of the latest report produced by the Adult Education Committee of the Board of Education— "Natural Science in Adult Education" (H M. Stationery Office. 6d net) The main points which emerged from the speeches and discussions were that the study of science should be an integral part of adult education: that students will be forthcoming if the subject is taught in a humanistic spirit; that fuller co-operation between universities, technical colleges. local education authorities, and voluntary organisations is essential; and above all, that the supply of teachers capable of treating science in a broad as well as a thorough fashion must be greatly increased.

Commenting on the Board of Education report, Sir Benjamin Gott maintained that a real interest in natural science exists among ordinary people and can easily be developed if the prospective student is made aware that he will be studying something about his home, his health, his work—and if teachers will simplify their language. But boys and girls must be caught when they leave school, and not allowed to drift till they reach the twenties. Moreover, it must be recognised that over-specialisation in teaching is an evil: teachers are needed who can show the interrelation of sciences. Mr. Norman Walker stressed the importance of the experimental method-of which he gave a fascinating example—and its power to win the lasting devotion of very humble and unlearned people, though perhaps he exaggerated his advocacy when he remarked that "those who have no capacity for teaching should leave the profession -or lecture ' "

In a brilliant address, Prof. Desch showed how even technological studies could be treated humanistically. by presenting them in a historical and biographical setting and explaining their sociological significance. He suggested that the bridge between science and other liberal studies might be found in sociology, and declared that our need is not met by the addition of scientific and humanistic studies one to the other, but only by a synthesis of the two groups Dr. Varley said that, for purposes of administration, education is cut up into too many divisions, and pointed to the importance of the fact that technical colleges are now recognised as centres of higher education without limitation of the curriculum. Classes in literary subjects are provided there and attended by many students for purely cultural purposes. The trouble is that young folk who finish their technical courses at the age of nincteen or twenty have been absorbed for some years in vocational preparation, have not developed an interest in humanistic studies, and see nothing further for them m our educational system. He therefore advocated the bringing of adult classes into the technical college and the provision there of a Common Room so that a social atmosphere might be created. Prof. Nunn, in the closing session of the Conference, urged that the science to be taught to adults must be the real thing, not merely the history of science (valuable as that aspect is), and that the natural result would be to make people scientifically minded. He observed a rhythmic process in which from wonder students pass to a sense of the practical value of science and then to a desire for systematised

thought In his view the study of science would lead to a deeper and more widespread interest in philosophy. Sir John Sankey, in his presidential address, spoke of the way in which science, having made increased productivity possible, should also show the way to a proper distribution of our material resources and to the enrichment of our social and spiritual life. Above all, it should teach us a respect for fact and a humility in judgment which would transform our personal and social relationships.

# University and Educational Intelligence.

BIRMINGHAM —The new biology block of the Unversity, which is to be formally opened by the Prime Minister on Oct. 20, is a very important addition to the building on the Edgbaston site. The new block forms part of the 'curtain' fronting on University Road, and extends from the chemistry block to the Harding Library, a distance of nearly 100 yards. It provides accommodation for the Departments of Botany, Zoology, and Biochemistry and Brewing

The ground floor is allotted to zoology, and comprises large and well-lighted elementary, advanced, honours and research laboratories, museum, insect room, departmental library, rooms for the professor and staff. lecture room, dark room, stores and animal A large part of the first floor is occupied by the Biochemistry and Brewing Department, and contains a large general laboratory, analytical and research laboratories, professor's and lecturers' rooms and laboratories, an admirable microscope room, balance room, incubator room, lecture room, and a departmental library The remainder of this floor is assigned to botany, and includes a large and welllighted herbarium, staff rooms, and special rooms for The second floor constitutes the main part of the Botanical Department, with large elementary and advanced laboratories, a laboratory for vegetable physiology, museum, lecture room, and departmental library, professor's and lecturers' rooms and laboratories, balance room, dark room, and store-

Rising above the general roof level of the 'curtain' is a large theatre which will be shared by all these departments. The building is heated throughout with hot water circulated by electric pump from a steam heated calorifier. General ventilation is furnished by fans in addition to the usual window openings. The windows on the south side look on to the great court, and those on the north look across the University Road to the land (at present arable and pasture) which has been recently acquired as an extension of the University site.

Important additions have also been made to the Chancellor's Hall (the hall of residence for men students). This will now accommodate about 100 men, and the new wings are to be opened by Mr. Baldwin.

London.—The following courses of free public lectures are announced: Six on "Vision." by R. J. Lythgoe, at University College, at 5 o'clock, on Oct. 10, 12, 17, 19, 24, and 26; three on "Hydrogen Ion Concentration," by Mrs. P M T. Kernidge, at University College, at 5 o'clock, on Oct. 14, 21, and 28; and four on "Heat Transfer in Reciprocating Engines, including Internal Combustion Engines," by Prof. A. Nagel of Dresden (in English), at the Institution of Civil Engineers, at 5.30 o'clock, on Oct. 11, 14, 18, and 21. The "Stevenson" free public lecture on "Eugenics in the Future" will be given by Major Leonard Darwin at Bedford College for Women on Oct. 25 at 5 15.

Newcastle-on-Tyne —Mi J O Cooper has been appointed lecturer in zoology at Armstrong College in succession to Dr A. D. Peacock, who is going to University College, Dundee, as professor of zoology.

The Huxley lecture in connexion with the Charing Cross Hospital Medical School will be delivered at the school on Thurslay, Nov. 24. by Sn Archibald Garrod, who will take as his subject "Diathesis"

SIR ARTHUR KEITH IS giving museum demonstrations at the Royal College of Surgeons, Lincoln's Inn Fields, on Oct 14. 21. and 28, at 5 P.M., on recent researches into the reproduction and growth of bone, rheumatic and other changes in joints (Strangeways Collection), and congenital dislocation of the hip and other joints. The lectures are open to advanced students and medical practitioners.

"Professional Schools, Post-Graduation Courses, Specialist Studies in the Universities and University Colleges of Great Britain and Ireland, Session 1927-28." That is the title of a pamphlet recently issued by the Universities Bureau of the British Empire. "Of their [the universities] special fields of study." says the prefatory note, "the greater part is common ground, yet each of them has its special plots which it cultivates, in some cases with a view to the needs of the province which it serves, in others because it has been agreed, or arranged, that it shall undertake work for which there is but little demand." The purpose of the pamphlet is therefore to indicate the respects in which the institutions undertake work which is not common to them all Particularly useful is the section describing the distribution of subjects of study. They are arranged in alphabetical order under the usual headings of arts, science, law, medicine, and technology, and ought to save considerable research in the individual university calendars. Thus, in the case of protozoology, London (Lister Institute), Edinburgh, and Glasgow are indicated; in the case of railway economics, the reader is referred to London and Manchester In technological subjects such as photography, rubber, sugar, textiles, etc., the special provision made by certain technical institutions is described.

The East London College Calendar for 1927-28 announces the opening of a new hall of residence for men students, the requisite funds for which were provided by the Drapers' Company (£6000) and H.M Government (£5000). The College Council has instituted a fund for the encouragement of original investigations by the staff and students and offers three research studentships of £50 annually. It is one of the few university institutions in Great Britain which offer courses in aero-engineering. The Northampton Polytechnic Institute also has an aeronautical laboratory, and its Engineering Day College announcements for 1927-28 give particulars of third and fourth year courses in aeronautics, aero-engines, and aeronautical drawing and design. Another speciality of this Institute is its department of applied optics, in which work is conducted as part of a complete scheme of optical education in London, including advanced classes for graduates at the Imperial College of Science and Technology. The Battersea Polytechnic, which offers full day and evening classes in preparation for University of London degrees in science, engineering, and music, includes among the subjects of its specialist courses architecture, flour-milling, domestic science teaching, and health visiting. A special feature of its organisation for social life is its day students' representative council, which tends to the maintenance of some continuity in the activities of the various students' clubs and societies.

# Calendar of Discovery and Invention.

October 2, 1901—The first British submarme, launched at Barrow on Oct. 2, 1901, was 63 ft. long and 11 ft. 9 m. wide. From the sixteenth century onwards, numerous attempts were made to produce a boat to travel under water, but the early models failed because they relied on man-power for propulsion. The greatest impetus to submarme building came with the 'Holland' vessel, constructed about 1897 by J. P. Holland in America. It was propelled by a gasolene engine on the surface, and used electricity for under-water work. It also had planes, which could be inclined to assist in diving and rising

October 3, 1846.—Gun-cotton was the invention of Prof Schonbem, of Basel, and was made known in 1846. On Oct 3 of that year, the Diet of Frankfurt voted a recompense of 100,000 florins to Schonbem and Dr Boettger, as inventors of the explosive, provided the authorities of Mayence, after seeing it tried, pronounced it superior to gunpowder as an explosive. Improvements were made by Baron von Lenk, an Austrian officer, about 1852, and in 1862 details of the manufacture were communicated to the British Government.

October 4, 1877.—The Ingram web rotary machine, invented by Mr. (later Sir) W. J. Ingram, M.P., for printing illustrated newspapers, was first used to print the *Illustrated London News*, Oct. 4, 1877.

October 5, 1896.—At the Paris Academy of Sciences on this date, MM. Berthelot and Vieille read a paper describing researches which had been made with the view of seeing what precautions, if any, are necessary in the preparation, compression, and storage of acetylene for commercial purposes. Acetylene was discovered by Edmund Davy in 1836, and first systematically examined by Berthelot. Wohler, in 1862, prepared it by the action of water on calcium carbide, but its use as an illuminant only became practicable in 1892 when Moissan and Willson showed that it was possible to make calcium carbide on the commercial scale in the electric furnace. Storage of the gas by dissolving it in liquids such as acetone was first suggested by Claude and Hess in 1896. Later Janet and Fouche found that acetylene dissolved in acetone absorbed by a suitable porous material could not be made to explode.

October 6, 1807.—Potassium was isolated by Davy by electrolysis of the fused hydroxide on Oct. 6, 1807 By a similar method Davy isolated metallic sodium. The method of manufacture on the commercial scale was given its first impulse by Deville in 1854, and in consequence of the improved processes it became possible to sell sodium at 10s. a pound in 1868. The modern Castner electrolytic process was introduced in 1890.

October 7, 1847.—Sir Isaac Holden and Samuel Cunliffe Lister were responsible for great developments in the machinery for wool-combing. On Oct. 7, 1847, a patent was taken out in their joint names for a new method of carding and combing and preparing genappe yarns, and when the machinery had been brought as near perfection as possible, factories were built which in time became the largest wool-combing concerns in the world. The business was concentrated chiefly at Bradford, to which city it brought prosperity.

October 8, 1884.—On this date, Rodney, an ironclad battleship of the Benbow class, was launched at Chatham. The modern ship of the same name was laid down on Dec. 28, 1922, with her sister ship Nelson Her length is 702 ft, beam 106 ft., mean draught 30 ft., and normal displacement 35,000 tons.

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### Societies and Academies.

Paris.

Academy of Sciences, Sept. 5 -Paul Marchal The natural strains of Trichogamma -Riquier · The investigation of the numerical solutions of any system of integral algebraical equations with any number of unknowns - Léon Pomey · The existence of non-linear, partial differential equations which are quasi-normal.—J A Lappo-Danilevski The algorithmic solution of the problem of Riemann.—Jean Chazy. The advances and retardations of the times of passage of Mercury on the sun's disc—Raoul Ferrier The theory of the molecular field—F. Gonseth and G. Juvet The equations of electromagnetism and Schrodinger's equation in a five dimensional universe —Lucien Vallery The stability of the catalytic properties of palladiumised asbestos. Details of experiments bearing on the determination of hydrogen in the atmosphere by the action of asbestos coated with palladium. Traces of hydrogen arsenide and antimonide do not appear to poison the catalyst, neither does the catalytic power of the metal appear to be affected by repeated use —Pierre Thomas and Mile Marie Sibi Contribution to the study of the structure of jellies Researches on the crystallisation of l-arabinosazone By the addition of a suitable foreign substance it is possible to modify the crystallisation of arabinosazone in such a manner that a pseudo-gel is produced. It is probable that the presence of impurities is a necessary condition for the production of gels of this nature, containing long hair-like crystals.—A Demolon and G. Barbier The application of viscosimetry to the study of colloidal clay. Some information can be obtained of the modifications of the state in a suspension of colloidal clay, especially the influence of electrolytes, by measurements of viscosity It should be noted, however, that these suspensions do not obey Poiscuille's law, and hence the results have only a relative value -Pereira de Sousa: The basalts of Portugal. At Lisbon and in its neighbourhood there have been at least two series of volcanic eruptions showing differences in their chemical composition -O Munerati and A. Milan: The possibility of detecting the presence of forage beet-root and semi-sugar beet-root amongst sugar beet at the commencement of growth.-L. G. Seurat: The presence of Mercierclla enigmatica m a river m Tunis—G. Mouriquand, A. Leulier, and P. Sédallian: The pH and the alkaline reserve in C-avitaminosis —Edouard Chatton: The meiotic gametogenesis of Paradinium Poucheti.

# CAPE TOWN.

Royal Society of South Africa, July 20.—A Ogg: The symmetry and crystalline structure of the crystals potassium, ammonium, rubidium, and casium sulphate. The crystals were shown to belong to the space group  $Q_h16$  in Hilton's notation ( $V_h$  16 Schonflies notation). The elements of symmetry are

Reflection planes  $(100)_{\frac{1}{4}}$ ,  $(100)_{\frac{3}{4}}$ . Glide planes  $(010)_{\frac{1}{4}}$ ,  $(010)_{\frac{3}{4}}$ . Translation c/2,

 $(001)_{\frac{1}{4}}, (001)_{\frac{3}{4}}.$  Translation  $\frac{a+b}{2}$ .

with the corresponding dyad screw axes and centres of symmetry. The unit contains 4 molecules and the molecule has a molecular plane of symmetry. The proposed structure shows the  $\mathrm{SO}_4$  group in tetrahedral form, the distance between S and O centres being  $1.5\,\mathrm{\mathring{A}.U.}$  The nearest approach of a K centre to an O centre is  $2.7\,\mathrm{\mathring{A}.U.}$ , and slightly increased distances for other members of the series. The structure gives an explanation of the twinning of these crystals and the

formation of almost true hexagonal prisms -P. R v Copeman. Studies in the growth of grapes (Part 3). The effect of environment upon the growth constants. The same type of equation is applicable to grapes grown in various localities, but the values of the constants in the different equations are directly affected by changes in environment. It seems that plants are affected by environment to a greater extent than animals. Changes due to environmental conditions are greater than those due to seasonal conditions—J. F. V. Phillips The behaviour of Acacia Melanoxylon R Br. (Tasmanian blackwood) in the Knysna forests an ecological study 'Blackwood' acts detrimentally upon the regeneration of the more important forest species, and is a plant which might become commoner it forests containing its dormant seeds were to be distributed. Despite its value as a tunber tree and its efficiency as a killer of weeds on open sites, it is not considered wise to plant the species in gaps in the main forests.

#### WASHINGTON.

National Academy of Sciences (Proc., Vol. 13, No. 7, July).—George A. Baitsell Additional evidence as to the intercellular formation of connective tissue Inoculation of living tubercle bacilli into the testis of the guinea-pig causes degeneration of the seminiferous tubules. In the intertubular spaces an abundant exudate appears which is quickly transformed directly into fibrous tissue.—W. M Copen-Results of heteroplastic transplantations of the heart rudiment in Amblystoma embryos. The whole and also part of the heart rudiment was transplanted from a large species of salamander into a smaller species and vice versa. The development of the whole heart rudiment and also the pulse rate seemed to depend mainly on its origin. The nerve supply comes from the host species but the heart muscle retains its own specific rhythm—A. E. Hopkins: Vision and retinal structure in mice. By means of an electrical punishment plate, mice in a box were trained to choose one of two outlets with coloured papers or illuminated with coloured lights. The animals seem generally to be colour-blind; their retine contain no structurally differentiated cones—J. B. Green and R. A. Loring: Zeeman effect and structure in the spark spectra of tin (preliminary report) —Francis A. Jenkins: The structure of certain bands in the visible spectrum of boron monoxide.-Carl Barus: Pressure phenomena of the mucronate anode Measurements with the interferometer Ugauge indicate that sharp surfaces of maximum and minimum potential surround an anode and cathode respectively at a distance of about half a millimetre from the electrodes—J. W Beams and Ernest O. Lawrence: On the lag of the Kerr effect. Light from a spark gap passes through a Nicol prism, two Kerr cells and another Nicol. The plates of the Kerr cells are connected with the spark gap by variable leads; if he leads are equal and there is no lag or equal lao in both Keir cells, no light passes out of the system. With different liquids in the Kerr cells, or with the cells at different temperatures, the difference of the lengths of the leads divided by the velocity of light gives the relative time lag of the Kerr effect The lag increases with viscosity and decreases with rising temperature, is constant for a given liquid for all wave-lengths, and is greater for polar molecules. The results accord with the theory that the Kerr effect is due to orientation of molecules with lag due to molecular, frictional, and inertial forces.—L. B. Loeb and L. Du Sault: Mobilities of ions in acetylene hydrogen mixtures. The mobilities of positive and negative ions in acetylene are probably the same; a lingher mobility observed for the negative ion is due

to the presence of electrons. In mixtures with hydrogen, there is no certain indication of clustering effects—Francis B Silsbee Current distribution in supraconductors The critical current' is that at which the magnetic field due to the current itself is equal to the critical magnetic field.—F. Zwicky: On the reflexion of electrons from crystal lattices The whole effect is produced by a few lattice planes near the surface A theoretical explanation is developed—R. C Gibbs and H. E. White. Displacement of certain multiplets and multiple levels for elements in the first long period Using the irregular doublet law and the regular displacement law of multiplets, certain characteristic multiplets of Cr III and Mn III have been located -R. A. Millikan and I. S Bowen Energy relationships and ionisation potentials of atoms of the first row of the periodic table in all stages of ionisation The most useful graphical exposition is to plot atomic number against the square root of the frequencies of the energy levels.—F E Wright: Polarisation of light reflected from rough surfaces with special reference to light reflected by the moon Measurements have been made with a polarisation photometer filled to the 12-in refractor of the US Naval Observatory of the amount of polarisation of light reflected by the moon At new moon and full moon, practically none of the reflected light is polarised, the maximum amount occurs at the ends of the first and third quarters and does not exceed 15-25 Comparison with the effects given by per cent. terrestrial substances indicates that the surface of the moon turned towards us consists largely of pumiceous substances high in silica, powders of transparent substances, quartz porphyries and possibly trachytes and gramites. There seem to be no dark rocks low in silica such as basalts, no masses of iron, no large nce masses or glassy obsidians, and no powders of basic rocks.—Willard J Fisher, Esther L Wurl, and Marjorie S. Desmond: The trails of two periodically flickering meteors.—Bernard Lewis: The unimolecular decomposition of azo-methane; the adequacy of activation by collision.—G. L. Clark, R. H. Aborn, E. W. Brugmann, and R. L. Davidson: On X-ray diffraction patterns from liquids and colloidal gels (see NATURE, July 23. p. 119)—Florence R Sabine and Charles A. Doan The effect of tubercle bacılli and the chemical fractions obtained from analysis on the cells of the connective tissues in rabbits. The action in labbits of the proteid and phosphatid fractions from human tubercle bacilli was followed by neutral red. The proteid is toxic, is associated with damage to endothelium and has a pressor effect on clasmatocytes; the phosphatid causes local production of tubercular tissue.—D H. Campbell. The embryology of Equisetum debile Roxb. The buds producing secondary shoots are endogenous, thus resembling the primitive fern. Ophioglossum.—F E Denny. The effect of small amounts of chemicals in increasing the life activities of plants. Citrus fruits which are commercially ripe are often partly green. If they are stored in a chamber containing a small concentration of ethylene (1 in 5000), they ripen off quickly. The metabolism of the fruit is hastened. Similar enhanced activity has been found in dormant buds and other plant tissues stimulated by various apparently unrelated chemicals. The effect may be of the nature of an incipient wound response—Neil M. Judd: The architectural evolution of Pueblo Bonito. Pueblo Bonito sheltered two distinct peoples; the founders, who used a single type of masonry, and a second group, who evolved three types of masonry and created for Pueblo Bomto its prestige The site was abandoned about a thousand years ago. Neither people had beasts of burden or metal tools.

#### Official Publications Received.

Board of Education Prospectus of the Royal College of Art, S Kensington, London Session 1927-1928 Pp n+28 (London H.M Stationery Office) 3/2 net
The Royal Aeronautical Society List of Members, September 1927-1940 (London)
Palestine and the Emp re Marketing Board Dr. J B Orr, on Agriculture in Palestine
Zonist Organisation)
Memorrs of the Geological Survey of India Palesontologia Indias

Dr. J B Ort, On Agriculture in Palestine Pp 24 (London The Zonist Organisation)

Memoirs of the Geological Survey of India Palæontologia India New Series, Vol 14. A Sivapithecus Palate and other Primate Fossis from India By Dr Guy E Pilerim Pp 1v+2v+1 plate (Calcutta Government of India Central Publication Branch) 18 rupees; 25 bil The Royal Technical College, Glasgow Calendar for the One Hundred and Thirty-second Session, 1027-1025 Pp. 410+xxvii (Glasgow)

Lawes Agricultural Trust Rothamsted Experimental Station, Harpenden Report 1925-26 with the Supplement to the "Guide to the Experimental Plots" containing the Yields pri Acre, etc. Pp 156 (Harpenden) 25 bil Institution of Electrical Engineers Edited by P F Rowell Vol 65, No 3rd, September Pp 820-912+xxxii (London, E and F N Spon, Ltd ) 105 bil Northampton Polytechnic Institute, St John Street, London, E C1 Excerpts from Announcements for the Session 1037-1928 Evening Classes in Telegraphy and Telephony. Pp 19 Evening Classes in Civil and Mechanical Engineering Pp 30 Evening Classes in Electrical Engineering Pp 40 Evening Classes in Applied Chemistry Pp 24 Evening Classes in Applied Optics Pp 32 The Engineering Pp. 10 Lasses in Applied Optics Pp 32 The Engineering Day (College Pp. 38 The Membership and Social Activities Pp. 7. (London.)

Cloudon.)

The British Institute of Philosophical Studies. Syllabus, Session 1927-28. Pp. 10 (London)

Proceedings of the Royal Irish Academy. Vol 37, Section A, Nos 8, 9 Mathematical Investigation of the Thrust experienced by a Cylinder in a Current, the Motion being Periodic, by Prof. J L. Synge, Time Measurement in an Isotropic Space Frame, by Prof. J L. Synge, Pp. 95-115. Is. Vol. 37, Section B, No 22 A List of the Hymenoptera Aculeata (Sensu Lato) of Ireland By Arthur Wilson Stellox. Pp. 201-355

52. Vol 37, Section B, No 23 Marcelin Berthelot, 1827-1907; a Biographical Note By Dr W. R. Fearon. Pp. 350-380. 6d. Vol. 37, Section B, Nos 24, 25 The Hydrolysis of n-Butyl Nitiate, by Dr. Hugh Ryan, Dr. John Keane and John C. M. Gallon. Pp. 301-372. 6d. (Dublin. Hodges, Figgis and Co., London Williams and Norgate, Ltd.)

Transactions of the Royal Geological Society of Cornwall Vol. 15.

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Of (Dudum. Hodges, Figgs and Co , London Williams and Norgate, Ltd.)

Tran-actions of the Royal Geological Society of Cornwall. Vol 15, Part 8. The One Hundred and Thirteenth Annual Report of the Council, with the Reports of the Treasurer and Cuiator, and Papers read to the Society Pp vin+539-598. (Penzance) 48
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#### FOREIGN.

FOREIGN.

Proceedings of the United States National Museum. Vol 71, Art 20-Pycnodesma, a new Molluscan Genus from the Silurian of Alaska By Edwin Kirk. (No. 2692) Pp. 9+2 plates (Washington, D.C Government Printing Office) League of Nations: Health Organisation. Principles and Methods of Antimalarial Measures in Europe: Second General Report of the Malaria Commission. (C.H./Malaria/73.) (Publications of the League of Nations III Health. 1927 III. 5) Pp. 95 (Geneva: League of Nations; London: Constable and Co., Ltd.)

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Annual Report, January 1, 1920—pecember 31, 1920 Fp. MY+218 (New York City.)

Bulletin of the National Research Council. No 61 Transactions of the American Geophysical Union, Eighth Annual Meeting, April 28 and 29, 1927, Washington, D.C. Pp. 297 (Washington, D.C.: National Academy of Science) 3 dollars

Memoirs of the University of California Vol. 8. The Antisterility Vitamine—Fat Soluble E. By Herbert McLean Evans and George O. Burr; with the assistance of Theodore L. Althausen. Pp v+176+12 plates. (Berkeley, Calif. University of California Pre-s; London Cambridge University Press.) 5 dollars.

Publikationer fra det Danske Meteorologiske Institut. Communications magnetiques, No 3: On the Heating of the Uppermost Atmosphere caused by Cathodic Rays from the Sun, by Helge-Petersen No 4: Yaleurs instantanees des eléments magnétiques observes à l'Observatoire de Rude Skov a l'occasion de l'eclipse de soleil du 29 juin 1927: Rapport officiel; No. 5: Valeurs instantances et synchroniques des eléments magnétiques enregistrées à l'Observatoire de Rude Skov pendant la tempéte magnétique des 21 et 22 juillet 1927, Rapport officiel Pp. 9+6+6. (København: G. E. C. Gad.)

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(Catania) Annalou van de Steinewicht te Leiden Deel 15, Eerste Stuk, Catalogue of the Positions and Proper Motions of 1533 Red Stars By Dr C H Hins Pp 110 (Leiden)
Berzens Museums Aarbok, 1926 2 Hefte, Naturvidenskabelig Række, Pp 53+18+71+22 (Bergen A/S John Griegs Boktrykkeri)

### Diary of Societies.

#### SATURDAY, OCTOBER 1

Institution of Municipal and County Engineers (South-Western District Meeting) (at Municipal Buildings, Plymouth), at 11 a m Institution of Municipal and County Engineers (North-Eastein District Meeting) (at Shildon, Durham), at 2

#### MONDAY, OCTOBER 3

Society of Engineers (at Geological Society), at 6-R C Hall The Lead Electric Accumulator in Practice

South of Chemical Industry (London Section) (at Royal Society of Arts), at 8 — W J. A Butterfield. The Gas Industry, Past, Present, and Future (Chairman's Address)

#### TUESDAY, OCTOBER 4

Institute of Merals (North-East Coast Local Section) (at Armstrong College, Newcastle-on-Tyne), at 7 30 —H Dunford Smith. Chan man's Address

man's Address
SHEFFIELD METALURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 730—A J Dale Reflactores in the Iron and Steel Industry
INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Automobile Club), at 8—Major E G Beaumont The Influence of the Automobile User upon the Automobile Engineer (Presidential Address)
LIVERPOOL PSYCHOLOGICAL SOCIETY (at Liverpool University)—Dr. S
Barton Hall Dreams and Dreaming (Inaugural Address)

#### WEDNESDAY, OCTOBER 5

ENTOMOLOGICAL SOCIETY OF LONDON, at 8

ENTOMOLOGICAL SOCIETY OF LONDON, at 8
SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8—A Chaston Chapman The Oil of tentrophorus quantiosus—Dr W R Schoeller and E C Deering Investigations into the Analytical Chemistry of Tantalum, Niodium, and their Mineral Associates 1X The Separation of Tintanium from Tantalum and Niodium.—C L Hinton and T Macaia. The Determination of Aldose Sugars by Means of Chloramine-T, with Special Reference to the Analysis of Milk Products

INSTITUTION OF SANITARY ENGINEERS.

# FRIDAY, October 7

JUNIOR INSTITUTION OF ENGINEERS (at 30 Victoria Stiest), at 730 — E Edser Lubrication (Lecture) Society of Chemical Industry (Manchester Section) — C J. T. Cloushaw Chairman's Address

CHORDAN CHRISTIAN ASSOCIATION (at Caxton Hall, Westminster)— E L Bass Some Fuel Experiments in a Mechanical Injection Oil

SATURDAY, OCTOBER 8.

BIOCHEMICAL SOCIETY (at Cambridge)

#### PUBLIC LECTURES.

WEDNESDAY, OCIOBER 5

King's College, at 5.80—Prof D MacCallum Blair. The Brothers Hunter—a Landmark in Anatomy.

LONDON SCHOOL OF ECONOMICS, at 6—W. Sansom Office Machinery The Moon-Hopkins Machine.

#### THURSDAY, OCTOBER 6

University College, at 2 30—Sir Flinders Petrie Egyptian Architecture—At 5.15—Di T. G Pinches Recent Discoveries in Babylonia King's College, at 5 30.—S Smith Babylonian Architecture

### FRIDAY, OCTOBER 7.

King's College, at 530—Prof S. Ahmad Khan The Growth of Primary Education in India from 1920 to the Present Day. University College, at 530.—Prof J M. Carré Michelet et l'Angle-terre in French. terre (in French)

# SATURDAY, OCTOBER 8

HORNIMAN MUSEUM (Forest Hill), at 330.—Prof J. R Amsworth Davis The Romance of the Spice Islands

#### CONGRESSES.

OCTOBER 3 TO 7.

IMPERIAL SOCIAL HYGIENE CONGRESS (at Caxton Hall, Westminster).

OCTOBER 4 TO 7.

Congress of Alimentary and Metabolic Diseases (at Vienna)

OCTOBER 8 TO 11

INTERNATIONAL CONGRESS OF HYDROLOGY, CLIMATOLOGY, AND GEOLOGY (at Lyons). OCTOBER 11 TO 15

FRENCH CONGRESS OF MEDICINE (at Paris).



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# The Interpretation of Science.

THE British Association is not the only organisation in Great Britain having for its avowed object the advancement of science. Every learned society, all the various bodies dealing with the professional interests of scientific and technical workers, are whole-heartedly devoted to the same cause. But the British Association has very special functions in addition to those of giving "a stronger impulse and a more systematic direction to scientific inquiry" and promoting "the intercourse of those who cultivate science." It was also called into being to obtain more general attention for the objects of science, for which purpose it set itself the task of familiarising the general public with the progress of scientific research and developing a consciousness of the effects of such research upon man's material and intellectual progress. Such activities are essentially complementary to those of the learned societies, the function of which it is to provide specialists with the necessary facilities for meeting others engaged in the same particular branch of science, and for the appraisement and publication of their work.

Specialisation in science is inevitable. It is indeed doubtful whether the present division of the scientific members of the British Association into sections and sub-sections corresponding with the principal branches of science is adequate to their needs. Thus, the exponents of a growing and most important branch of science like bio-chemistry may find the time quite insufficient which is allotted to them in the chemistry section, or in joint meetings of that with other sections Again, those engaged in aeronautical research may feel that neither the Section of Mathematical and Physical Sciences nor that of Engineering gives their field of inquiry the consideration it deserves. It would occasion no surprise, therefore, if further subdivisions were made in the near future.

It is perfectly clear that the more specialisation there is in science the more need there is for the Council of the Association to exercise the greatest care and vigilance to prevent the obscuration of its main object. Even for scientific workers there are special advantages attached to membership of the Association. At each yearly meeting they are provided with unrivalled opportunities for meeting with others drawn from all parts of the world and discussing their work, for surveying the progress made in their respective branches of science and for becoming acquainted with the advances made in practically every other field of scientific endeavour.

In return for these very real privileges gained for them by the growing prestige of the Association, they could and should be expected to pay more regard to the desire of the lay members who attend its meetings, and the general public which reads the reports, for the presentation of the advancement of science in language intelligible to the non-specialist

It must be remembered that the British Association is not purely a professional body like the British Medical Association, Iron and Steel Institute, Institution of Naval Architects, and similar organisations which hold meetings at different centres year by year It invites the general public to become members, and many of them do so at every place where a meeting is held Association were a closed corporation of workers in pure and applied science which met to discuss the position and progress of particular branches of natural knowledge, the character of the proceedings would be its own affair As, however, a fairly large proportion of its annual members belong to the lay public, it owes a debt to them as well as to the scientific members; and we doubt whether this duty is fully met by the provision of the Citizens' Lectures, though the lecture on "Energy" delivered by Sir Oliver Lodge at Leeds was a brilliant example of what can be accomplished in this direction. We suggest that each section might appropriately devote at least one afternoon meeting to a lecture or discussion of what may be conveniently described as a Royal Institution type, that is, intended for intelligent people who are interested in advances of science and yet are not actual workers in the particular department to which the subject refers. It would be found that there are many scientific workers who would be glad to attend such accounts of progress in fields outside their own, in addition to members of the general public who join the Association in the hope of obtaining such enlightenment.

As to the presidential addresses, however specialised may be the field of research of any president of a section, upon him or her rests the responsibility not only of relating special studies with one particular branch of science, but also of making every effort to establish contacts with other fields of scientific inquiry and to demonstrate the essential unity of purpose of them all. This responsibility can be shouldered neither by the General Committee nor by the Council. But the Council of the Association obviously has the right to expect that organising committees will assist in preventing the annual meeting from developing into summer vacation meetings of a number of learned societies.

If any one doubts that there is a growing tendency in this direction, let him examine the subjects chosen by authors and the summaries supplied for inclusion in the journal of transactions of the Association for the past few years. Some of the subjects are so specialised in scope that it is improbable they could have been of interest to more than a few members of the particular section to which they were delivered. Many of the summaries are couched in such highly technical language that even the special scientific correspondents of the great newspapers find them unintelligible.

There would be little occasion for lengthy comment were it only the youthful aspirants for scientific honours against whom this charge of obscurity could be brought We could rely upon time to purge them of the conceit of demonstrating familiarity with their newly acquired forms of expression in order to win a reputation for erudition Unfortunately, some of the addresses delivered by sectional presidents at Leeds displayed the same weakness. From the point of view of title, subject matter, and form of presentation, they were alike calculated to produce in many members of the Association a feeling of bewilderment. We do not doubt that these addresses are noteworthy contributions to the problems of particular fields of work, but as they are printed we suggest that they need not be read in the section rooms, or at any rate only those parts which can be followed intelligently by the section as a whole. There may still be some members of the general community whose respect for science is in inverse proportion to their capacity for understanding what is presented to them, but they are a dying race. Thanks to the reforms brought about in our national system of education since the beginning of the century, there is a large and everincreasing army of people equipped with enough knowledge of science to be hungry for more. The publication and large sales of certain popular handbooks on scientific subjects is a clear indication of this interest in the activities of our research workers.

The members of the general public who attended the Leeds meeting are in a position to judge of the quality of the communications presented as addresses and papers. Those who perforce had to rely on newspaper accounts of the proceedings will be mystified by the paucity of the references to those subjects which they regard as the exclusive domain of the scientific worker. While this can partly be attributed to the contempt which some reporters and editors have for the level of intelligence of their readers, most of the fault lies

with the authors of papers They are prone to ignore the fact that with so wide a range of choice of subject matter for copy, the press representatives will invariably seize upon that which is presented with such clarity as to dispense with the need for interpretation. For this reason the sections dealing with education, agriculture, and economics receive more than their proportionate share of attention in the newspapers.

It may be urged that certain subjects cannot be resented in a form calculated to appeal to a wide p 'alic. If that be the case, they should either not fina Nace in the proceedings of the British Association, or alternatively, the papers given at the annual meeting should be divided into two categories, those which are intended to appeal to a wide public and those which are for the exclusive benefit of specialists. It is inconceivable that in any of the branches of science represented by the thirteen sections there should not be sufficient material each year upon which to base an address to nonspecialists, and presidents of sections, as well as other authors of papers, would be well advised to prepare summaries of the main features of their addresses for advance distribution to the press They can rest assured that unless they can first interest the newspaper reporters they will have little opportunity of interesting the public in their work. They need not fear, moreover, that a reporter will rest content with a summary. A test of good journalism is the originality with which a subject is treated. Given a summary as a setting, the reporter will find jewels with which to adorn it

The advancement of science depends upon the encouragement of research. The public must be better informed if it is to appreciate to the full the need for more and more research. It will not willingly endow what it cannot understand scientific workers who attend the yearly meetings of the Association ask themselves why, in its wisdom, the Council holds each meeting in a different centre of population in the country Presumably it is done for its propaganda effect Bringing scientific workers into personal relationship with various sections of the community helps to destroy the illusion that we are a race apart. Clear exposition of science should also dispel the idea that scientific experiment is mere legerdemain, its mysticism heightened by a rigmarole of complex terminology. Explicit statement is the necessary precursor of wide publicity, without which there cannot be general appreciation of the aims and methods of science, of what science has achieved and what it might achieve for the human race.

# Science in Literature.

The Short Stories of H. G. Wells Pp. 1148 (London Ernest Benn, Ltd., 1927) 78 6d. net.

OTHING is so significant of the power of the old classical tradition as the extent to which the literature of fiction remains comparatively unmoved under the shock of scientific discovery. For the intellectual revolutions which have been effected during this past century by a mere handful of blandly inquiring scientists can be matched only by the social and industrial transformations to which they have unconsciously contributed in no small measure

To a scientist a new field of human experience and expression is opened up. He sees life unfolding, not merely as the old interplay of human emotion and passion, but rather in response to the widening environment developed by man's increasing knowledge. In the field of science, for him who has eyes to see, dramatic material is not far to seek, but current fiction remains singularly aloof. Here and there a detective, a pathologist, or a medical practitioner is created who plays his part against a suggestive background of mysterious knowledge, but there is no novelist, with the exception of Mr. H. G. Wells, in whom the dramatic element in scientific discovery evokes a sufficient response to urge him to action.

The strong human impulses associated with love and sex which have formed the keynote of so much of modern fiction are not absent in the work of Wells—far from it—but the psychological behaviour of the scientist, his interests, his urges, the material he handles, and the stage he treads, constitute a region into which none other than Wells has dared to enter

Coming to literary work from the field of technical knowledge, Wells has made the amazing discovery that a scientific training, far from being a handicap, is a positive blessing. A good novelist, if he is anything, is pre-eminently a psychologist. It is his function, by means of the technique of storytelling, to observe, to describe, and to analyse the thoughts and actions of mankind, and not merely that aspect of mankind constant throughout time, but mankind in the making. He stands at the point of vantage who absorbs with understanding the newer knowledge. Being artistic, such an analysis—in the creation of a novel it is really a synthesis—is not scientifically systematic differs from a study of a scientific problem in this respect, that no two novelists in their treatment will produce the same result. The final product is

dependent on the mentality of the solver the psychological study developed by the novelist is, as often as not, a reflected study of the author Wells stands at this point of vantage, and in describing his vision opens up his mind.

Here, then, in the present group of short stories, we see Wells, a young imaginative artist, striding boldly into the field and with a few strokes creating a world which hums strangely in the ears of the old classical school. Tuned to the mentality of the scientist and alive to the trend of scientific thought, Wells enters the arena of fiction armed with weapons denied to his professional colleagues He may manœuvre in regions of the arena with assurance where others must hesitate to tread, and the earlier stories in this extraordinary collection show Wells disporting himself gaily and masterfully among the fantastic notions born of much of the speculative science of the late Victorian era.

Early hesitant knowledge of time and space are handled with assurance and imagination in "The Time Machine," "The Plattner Story," "The Strange Case of Davidson's Eyes." Sometimes his boldness is preposterous, as when in "My First Aeroplane" he makes a machine in 1912 stand up to treatment that no self-respecting aeroplane in 1927 would possibly tolerate without destruction. At other times it is almost prophetic, as in "The Land Ironclads," where in 1903 trench warfare and tanks are described in unerring detail Again and again he traces the emergence of a world of wheels, and shafts, and furnaces.

It is easy to say that, in those early days of Wells's literary work, the young man is merely tickling the palate of the reader with a series of extravagant ideas. While it is probably true that a number of these stories are scarcely more than this, there recurs continually the suggestion that if mankind would only realise it, the potentialities for good and evil in modern scientific discovery on the mechanical side are enormous. There is, for example, "A Dream of Armageddon," "A Story of the Days to Come," and so on. There appears the implication to the scientific man that he must give himself pause to consider whither his newer knowledge may drive mankind, and to the layman the startling question as to whether he is indeed ready to receive this strange knowledge.

The theme changes slightly as Wells borrows from his biological experience. The power of natural selection as a factor in evolution is violently forced to our notice here and there. In "The Country of the Blind," the capacity of the human organism to adapt itself to environment, and the extent to No. 3023, Vol. 120]

which refinement in the senses may proceed in response to needs, are brought out with the skill of a master "The Empire of the Ants" teaches how survival of the fittest is by no means identical with survival of the most desirable In "The Time Machine "we are projected forward into futurity and are horrified to discover that mankind has long passed the zenith of its highest development and a kind of retrogression or involution has set in, 'n place of the higher evolution.

These ideas may be fantastic, they may be mere examples of mental agility and imaginative strokes of a young man in a field yet unopened to assured knowledge. But we begin to perceive that in the background of Wells's mind there exists a dominating urge. Mankind itself raises a problem of colossal magnitude—how to utilise the accumulating wealth of scientific knowledge in the design of a super-race—of a civilisation devoid of the stupidities and absurdities of social life as we know it.

These stories where they touch this issue scarcely do more than raise it Some indication of Wells's own line of approach to this difficult issue is provided by glimmerings of Utopias of various kinds that sparkle out here and there. It is in his larger and more mature works that these ideas are worked out in greater detail, but, on the whole, Wells on the constructive side is much less satisfying than at his favourite game of thought provoking. Utopias are literally as old as Adam, but it is permissible to doubt whether the mental exercise in their design ranks higher than that used in the solution of a crossword puzzle.

It is possible that in a sense they may serve the useful function of preparing the minds of some for the possibilities that might be achieved, for the ideals to which to strive. But imaginative gropings in a dim future, with roseate pictures of the dawn of a new era when man will grasp the forces of Nature in the hollow of his hand, will not provide a solution of the immediately pressing problems of production, distribution, and exchange; for the question uppermost in every one's mind, both scientist and layman, is, "What to do now?"

The kind of promise the imaginative Wells has held out in these early stories is not fulfilled by him in his later work. Doubtless, had his numerous love novels been left unwritten, the world of literature would have been enormously the poorer, but the far-reaching and vital questions which Wells himself raised have really not been faced by him. Instead, he has left it to the politicians, content to be a mere finger-post pointing towards an inaccessible region of the horizon. H. LEVY.

### The Formation of Roads.

- (1) The Science of Roadmaking · a Scientific and Practical Treatise dealing with Road Construction in its Modern Forms, for the Use of Surveyors, Contractors, Asphalt Plant Managers, etc. By John Wilfrid Green and Charles Norman Ridley Pp. xv + 138 + 5 plates. (London Crosby Lockwood and Son, 1927) 10s. 6d net
- (2) Management and Methods in Concrete Highway Construction By G L Harrison Pp ix +242 (New York McGraw-Hill Book Co, Inc., London McGraw-Hill Publishing Co, Ltd., 1927) 15s. net

IT will be generally recognised that the formation and laying-out of highways and crossroads have, until recent years, been far more in the nature of a science than an art, though art has begun to enter into its kingdom since the passing of John Burns's Town Planning Act, the first of the kind in the British Isles Not that with the advent of art into the matter of road-making science will function to any less degree. For though it is not every one who holds the view that science must of necessity retrograde in the absence of advancing, yet it is certain that modern progress in regard to the modes of travel must carry in its train scientific progress.

When any one takes thought of road-making, the memory of what the Romans accomplished in this direction is mevitably to the fore. Without staying to consider such local routes as they constructed in the City of the Seven Hills and other places of importance, it will suffice to recall those great military highways which so aided them in the control of their vast empire. England still possesses portions of these notable enterprises—as witness Watling and Stane Streets and others—which radiated from London (the Augusta of Roman days) throwing out their tentacles in various directions.

These Roman roads were, however, undoubtedly purely military and scientific; military in their nature and purpose, and scientific in their construction: art could claim no part in them. In the magnificence of Roman conception a military road was driven from centre to circumference with as close an approximation to a radial line as could be achieved; natural obstacles were for the most part overcome by means of bridges and tunnels, according to the gradients encountered. Mansiones or camps were established en route, though it is the customary Latin word for 'camp' which has survived to this day in the nomenclature of so many of our towns

The Roman roads were made to endure, like the Egyptian monuments of earlier date. It is only as the nature of the passing traffic alters and its volume increases almost beyond conception, that other routes, other methods and other construction, have had to supersede a system of incomparable virtue.

Perhaps it is giving too great credit to the British character to attribute the passing of the Roman highway to the necessities of the twentieth century—for the truth is, that long before its advent, British insouciance had consigned the memory of these military trophies to the limbo of neglect, if not, indeed, of oblivion.

The Roman thoroughfares were constructed on good scientific principles, a firm bottoming was obtained by ramming small stones and bats of brick into the ground, and on this foundation was laid a pavement of large stones accurately fitted like a mosaic pattern, the interstices being carefully jointed in cement. Where large stones were unobtainable, then a species of concrete was substituted, composed of small hard stones bound together with lime

Of course, these main highways accounted only for a mere fractional part of the means of transit necessary throughout Great Britain. Here British sluggishness of temperament asserted itself unalloyed. A mere path, sufficiently wide to enable a pack-horse to bear its burden, would gradually form itself, rather than be formed, in the required direction; even then it would not go straightforward, but would meander between and around the trees, thus in time providing us with those serpentine courses, which have a charm to the eye, even though regarded as practically undesirable. These tracks invariably followed the line of least resistance; the fordable part of a stream would be approached, whatever deviations might thereby be rendered necessary.

Thus these initially unobtrusive paths gradually became beaten tracks, widening sufficiently in time to admit of the passage of carriages meeting en route, though frequently even this was not accomplished. But as for any scientific construction, it can but be said that science was conspicuous by its absence. If Irish main roads were passably good (for the period), English were passably bad, whilst Scotch (according to a countryman's evidence, namely, Macadam) were atrociously bad

In England the main idea, so late as the early years of the nuneteenth century, seemed to be to barrel the roadway by arching it almost inconceivably high at the crown, with a very steep gradient to either flank. When the mevitable occurred, and the road became rutted as in a night-mare, the curative process consisted in filling up the ruts and making the crown usable by means of vegetable débris, loose stones, and general rubbish, all brought to a sufficiently smooth condition, so as to receive the cachet of the local authority (such as it was), and then—all would be da capo

This period of darkness endured until about a century ago, at which time the enlightened labours of Telford, Macadam and others served to bring about such improvements as paved the way for modern scientific production. There are many who still regard the method developed by Macadam as of value, even under the changed conditions of the traffic problem—mechanical transport, heavy in its nature and dense in its massing, convulsive in its movements and rapid in its passage. But science, ever on the alert, introduces new solutions to meet altered conditions, and so we find macadamised roads giving place to the use of granite setts, concrete, wood blocks, rubber surfacing, asphalt paving, and, most interesting perhaps of all, the reinforced concrete treatment of the substructure.

The progress of science makes welcome the production of literature dealing with the subject of road-making, and the two books under notice would seem to be one the corollary of the other, or perhaps they should be regarded as mutually interdependent. Messrs. Green and Ridley consider the subject from its scientific basis, dealing successively with hydrocarbons, bitumens, asphalt, sand, tar and pitch, cement and concrete chapter dealing with molecular structure and valency is peculiarly interesting, perhaps more so than many that follow. The authors have a high opinion of asphalt for the surfacing, and certainly it seems to take rank after macadam from the viewpoint of anti-slipperiness. The authors do well to state that "the reliance too often placed on maintenance guarantees by road surveyors is causing the substitution of a cheaper material, to the possible detriment of asphalt paving in general." Regarding the suitable-mixture diagram shown on page 49, there seems to be a lack of agreement with the text on the previous page; for the diagram apparently indicates the medium group as giving 12-50 per cent., and the fine group, 30-60 per cent., whereas the text reverses these figures.

It is properly remarked, that "in taking a No. 3023, Vol. 120]

sample of sand for the mechanical analyses or grade composition, care should be taken to secure same from the inside of the heap "; and the recommendation of tar macadam surface for motor traffic is well advised. But why should such solicitude be expressed on page 71 for fish, respecting the use of tar 2

The practical consideration of construction is developed in Mr. Harrison's book in a very interesting and masterly manner, and the business aspect is thoroughly regarded. Indeed, the main adverse criticism to be offered arises from the madequacy of many of the half-tone illustrations, which often need the base reference to produce intelligibility. It is a fact also, that some people might think that there is too great a fetish made of timekeeping to a second, but this meticulousness is recommended in the interests of the contractor. It is not possible to agree with the author (see page 184) that the table in fig. 7 shows a large percentage of time lost due to water trouble, though such loss is made manifest in the next figure The series of sixteen chapters is well worked out, and the graphs and diagrams in general are clear. It is not to be disputed that (within certain limits) the greater the method which can be introduced into a contract the more it makes for final satisfaction. This was eloquently manifested recently in the erection in Piccadilly of the new Devonshire House, which was worked out upon a schedule prepared by its American architect on lines of exactitude, such as Mr. Harrison recommends in his book on concrete highway construction. PERCY L. MARKS.

## Brain and Mind.

- (1) Thought and the Brain By Prof. Henri Piéron. Translated by C. K. Ogden. (International Library of Psychology, Philosophy, and Scientific Method.) Pp. xvi + 262. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1927.) 12s. 6d. net.
- (2) The Mind and its Mechanism: with Special Reference to Ideo-Motor Action, Hypnosis, Habit and Instruct, and the Lamarckian Theory of Evolution. By Paul Bousfield and W. R. Bousfield. Pp. vii + 224. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1927.) 9s. net.
- (1) THE last thirty years have witnessed the inauguration of a new era in the study of mental phenomena, the introduction of the discipline of scientific induction into a field of inquiry in which the deductive procedures of the

scholastic method had run riot for many centuries. The study of the evolution of the nervous system and the experimental investigation of its mode of working prepared the way for the understanding of the biological processes that express themselves as mental phenomena. Such researches as are associated with the names of Sherrington and Pavlov are clearly of fundamental importance for the interpretation of the working of the mind and for correcting the assumptions of introspective psychology. Armed with the results and the methods of experimental physiology, the psychologist has devised tests of his own to apply the method of experiment to the phenomena of mind and, under the leadership of Spearman, has attempted to express in mathematical form the fundamental analysis of mental ability so that it can be measured and subjected to the test of experiment.

Perhaps the most fruitful field of psychological inquiry has been provided, however, by the clinical study of the mental effects produced by injuries to the nervous system—in particular the vast experiments provided by bullet wounds in the War. Moreover, the anxiety states created by the abnormal stress and strain of trench warfare, and the moral and intellectual damage resulting from encephalitis lethargica since the War, have shed important light upon the emotional side of the mind's working. It is no exaggeration to claim that these three departments of clinical study have provided a new revelation of the dependence of mental and emotional expressions upon neural mechanisms. In the technical medical journals a vast amount has been written upon these subjects: in his great monographs on sensation and aphasia, Head has given his interpretation of the mental significance of nervous phenomena: many other books have been published dealing with the expression of the emotions and the psychological significance of the activities of the bram: but it remained for some psychologist to expound in generally comprehensible terms the new light shed upon the workings of the mind by recent research in clinical medicine

This difficult task has been attempted by Prof Henri Piéron, of the Collège de France. He has subjected to a critical but sympathetic examination the medical reports on the results of injury to brain and nerves, and has succeeded in giving a fair and reasoned analysis of the results achieved It is particularly interesting to find a French author expounding so lucidly Head's researches on sensation and aphasia. Though his acceptance of Head's

views is qualified, he has given his readers an unbiassed account of the methods and results and a generous appreciation of their significance to psychologists. His discussion of aphasia is particularly instructive. Summing up the history of research into the significance of speech-defects resulting from injuries to the brain, he gives a clear and just estimate of the contributions of Gall, Broca, Bastian, Charcot, Wernicke, and Pierre Marie; he concludes: "At present, in an atmosphere of thought impregnated with Bergson's powerful critique, so quickly assimilated that it has become impersonal, it is the intellectual analysis of the function of language, such as that attempted by Head, which has come to the front, and we are returning to the profound views of Hughlings Jackson, which were obscured by the brilliance and prestige of Charcot." This frank admission is distinctive of the fairness and impartiality of the author.

In translating this book into idiomatic English. Mr. Ogden has successfully accomplished a task of no mean difficulty. But it is unfortunate that he did not submit the proofs to an anatomist. for several of the technical terms, though literally translated, have emerged in curious forms. Thus the intracortical fibres known as the stria of Gennari, often referred to by French anatomists as the band of Vicq-d'Azyr, are called in this book (p. 254) "the bundle of Vicq-d'Azyr," which is the name of a very different kind of structure in another part of the brain. The figures also contain many inaccuracies-in particular Fig. 2 on p. 6. Special mention is made of these defects, because this book is one that will be particularly useful to the medical student; and some teachers might hesitate to recommend a work containing such lapses. In a new edition it would be wise to provide an entirely new set of illustrations. For the book deserves better treatment in this respect.

(2) The book by P. and W. R. Bousfield is a speculation that attempts to give concreteness to McDougall's conception of a psychical structure as part of the mechanism of mind. Thus the authors claim that they "have endeavoured to expand this more or less metaphorical conception by the hypothesis of a real psychic structure which is an essential part of the organism."

This search for an elusive mind-stuff seems to have been prompted chiefly by McDougall's claims that "the progress of our knowledge of the brain has shown conclusively that there exists no one part in which all sensory paths converge and which might be regarded as a sensorium commune" (p. 17),

and further, "that there exists in the brain no such physical medium of composition, and that the processes of the several sensory nerves simultaneously excited do not affect any common material medium to produce in it a complex physical resultant" (p. 18).

More than a quarter of a century ago I invented the term 'neopallium' for the definite cortical area where all sensory paths do converge and pour their currents into a continuous sheet of grey matter, which is a most definite and indubitable 'physical medium of composition.' Hence I am unable to accept the basal assumption of this book.

G. ELLIOT SMITH.

# Oxford Histology.

Histological Technique. for Normal Tissues, Morbid Changes and the Identification of Parasites By H. M. Carleton. Chapters vii. and viii, in collaboration with Frederic Haynes. (Oxford Medical Publications.) Pp. xv + 398. (London Oxford University Press, 1926.) 16s. net.

THIS book has been written by a young Oxford histologist who was trained in the Department of Zoology and Comparative Anatomy of Oxford. The author has had special experience in medical parasitology and a training in the various recently developed techniques for the study of the cytoplasmic inclusions of the cell. The present volume is not intended to be an exhaustive work on microtomy for the research worker in the same way as "The Microtomist's Vade-Mecum," but is planned to act as an introduction to the subject, and to lead up to more advanced investigations.

The first book on modern histological methods which emanated from Oxford was that of Gustav Mann, entitled "Physiological Histology," 1902 When the reviewer was histologist at Oxford, there was a faded piece of paper pinned behind the histology sanctum sanctorum which set forth the sales of Mann's book. So far as the paper showed, the book was a failure—that is, commercially—but "Physiological Histology" even now contains material not found in any other text-book of microtomy, and was a decade or so before its time.

Another noted Oxford histologist, Dr. S G. Scott, was a splendid type of the medically trained scientist. Scott specialised in the precise application and standardisation of the better-known laboratory techniques, such as those of hæmatology and colour reactions. Much of this worker's success was due to his special know-

ledge of the dyeing industry of Leeds Scott died during the War, and his book was never written Both "The Microtomist's Vade-Mecum" and "Histological Technique," however, contain many of Scott's formulæ and 'tips'

In recent years, owing not only to the kindly interest which Sir Charles Sherrington has shown in this subject, but also to Dr Carleton's enthusiasm, the Oxford Histology Department has been enlarged, and its facilities have been brought upto-date, "Histological Technique" will show that nowhere else is histology better taught and histological methods better understood

Much of Dr Carleton's book will be familiar to users of the "Vade-Mecum," and "Mallory and Wright." but it is not to be imagined that the author has not cut new ground The exposition of the carefully weeded out material is clear and concise, and undoubtedly the most admirable part of the volume, from the student's point of view, is the arrangement of "Tables of Faults" Why do sections curl? Why does the tissue fall out of the block? Why does the ribbon refuse to form? and so on In three columns, we have "Fault," "Diagnosis," "Remedy," as for example, "Sections crumble," "Paraffin too soft," and "Cool the block," as the remedy. Thus, a person working alone will find every facility for tracing out his difficulties and eliminating them. Some of the statements regarding the difficult chemical side of the subject found in Chaps, vii and viii, which were written in collaboration with Frederic Haynes. are a little doubtful, and one feels that this is the least happy part of the book

We are convinced that "Histological Technique" fills a long-felt want, and that the book is certain to go into many future editions. The author is to be congratulated.

J. BRONTE GATENBY.

# Citrus Fruits.

The Cultivation of Cutrus Frunts. By H. Harold Hume (The Rural Science Series) Pp. xxi + 561. (New York: The Macmillan Co., 1926.) 21s net.

crops cannot be over-estimated, for it includes fruits of such general use as the orange, lemon, lime, and grape-fruit, with others of less economic importance. This being the case, comprehensive books upon the subject are necessary from time to time, in order that growers in the many countries where these fruits are cultivated may be kept informed of improved varieties and better methods of cultivation and marketing as they are evolved.

All these points and others are dealt with in the work under notice; in fact the scope of the book is scarcely described by the title, for although a good many pages deal with the cultivation of Citrus fruits in a concise and altogether excellent manner, historical, botanical, and marketing problems are dealt with quite as succinctly.

Although the author only sets out to describe the position that Citrus fruits hold in the United States of America, he gives a fund of information that will be found to be of value to growers in other parts of the world. Commencing with a chapter on the "Commercial Importance of Citrus Fruits," the author indicates by tables the growth of the industry in Florida and California from the years 1886-87 to 1923-24 inclusive His records are taken from the number of boxes of fruit handled by the railway companies during that period, and it is illuminating to learn that whereas in 1886-87 1,260,000 boxes were despatched from Florida and 840,560 from California, in 1923-24 Florida sent away 20,399,614 boxes and California 24,292,800 boxes. In the chapter dealing with the botany of the Citrus fruits, the author gives descriptions not only of the species bearing marketable fruit but also of allied species and the few interesting hybrids that have been raised. He takes a limited view of both genera and species. The trifoliateleaved section, for example, that is so well represented by Citrus trifoliata Linn., he places under the generic name of Poncirus, whereas the Kumquat group appears under Fortunella. limits the range of the species retained in Citrus. Thus the lemon appears as C. medica Linn, the lime as C. aurantifolia Swingle, the shaddock as C. maxima Merrill, the pomelo or grapefruit as C. paradisi Macf., the sour or Seville orange as C. Aurantium Linn., and the sweet orange as C. sinensis Osbeck. The cultivated groups of Citrus truits are then divided up and the varieties cultivated in America are dealt with. Some 49 varieties of sweet orange are described under the sub-heads Spanish oranges, Mediterranean oranges, blood oranges, naval oranges. Sixteen varieties of pomelo or grape-fruit are described, with numerous limes and lemons.

The cultural part of the book deals with all operations from propagation and planting to the care of the mature trees. Manuring, treatment of diseases, pruning, collecting the crop, and many other aspects are discussed. Handling the crop and marketing is also a very useful section. The author is to be congratulated upon the production of a very complete and useful book. W. D.

# The Calculus of Variations.

Calculus of Variations By Dr A. R Forsyth.

Pp xxii + 656 (Cambridge . At the University Press, 1927) 50s. net.

PROF. FORSYTH'S latest work appears opportunely at a time when there is quite a notable revival of interest in the calculus of variations. To those who desire an account of the subject which, while modern, sound, and practical, is free from the extreme rigour so popular in certain quarters, this volume will be most welcome.

The first chapter contains a discussion of the early investigations associated with the names of Euler, Legendre, and Jacobi. Here the discarding of the irritating &-notation originally introduced by Lagrange has greatly clarified the exposition. In the second chapter an account is given of Weierstrass's modifications of the analysis when both the independent and the dependent variable are subjected to variations. The four following chapters deal with extensions to the cases in which the integrals involve derivatives of higher order than the first and more than one dependent variable.

Up to this point the variations considered are of such a nature that one smooth 'characteristic' curve is deformed into a neighbouring smooth curve. Such variations are described as 'weak' variations. In order to obtain complete solutions of the problems of the calculus of variations, it is necessary to consider the possibility of small 'jagged' or 'strong' variations. The discussion of such variations has shown that, while the tests employed in the older analysis are necessary, they are by no means sufficient; and, indeed, it has been found that some of the most important results believed to have been established by the older methods are no longer valid. Weierstrass investigated one simple type of these 'strong' variations, and an account of his work, and of his E-function, is given in chapter vii.

The eighth chapter deals with relative maxima and minima of single integrals, and the remaining four chapters contain extensions to double and triple integrals, the analysis in these naturally becoming more complicated. Throughout the book there are numerous examples fully worked out.

Though the calculus of variations has been studied spasmodically for some two hundred years, its development has scarcely yet reached a stage at which it would be possible to write a compact account of the subject suitable for use as a college text-book; but, to original workers, this treatise should prove both useful and stimulating.

# Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

#### Spectra of High-frequency Discharges in Super-vacuum Tubes.

The experiments of Kirchner (Ann. d. Phy., 4, 77; 1925) and of Gill and Donaldson (Phil. Mag. 2, 129) have shown that a tube, pumped down to what is usually termed a non-conducting vacuum, will give a brilliant discharge if excited at comparatively low voltage at a frequency corresponding to a six- or seven-metre wave, the current being fed to the tube through external electrodes of tin-foil. During the past summer we have made a further study of the phenomena exhibited by these high-vacuum tubes, with especial reference to the spectra of the discharge

The tubes were first given a drastic cleaning with caustic potash, alcohol, chromic acid, and distilled water. They were then dried and exhausted with a Holweck molecular pump, the walls being heated repeatedly during the process. A tube provided with internal electrodes, in the pump circuit, showed no discharge when connected to an induction coil giving a two-inch spark. We then excited the tube provided with electrodes of tin-foil with an oscillating circuit giving a three-metre wave. A brilliant blue discharge at once appeared (hydrogen spectrum), the general appearance of which would have led one to believe that the pressure must be of the order of a millimetre.

Discharges under the above conditions are attributed, by their discoverers, to a to-and-fro oscillation of the electrons, the time of transit down the tube being less than the time of the half oscillation of the electrical circuit.

We found that, if the pump was kept in action while the tube was excited, the blue hydrogen spectrum gradually disappeared, being replaced by the olive-green discharge characteristic of pure oxygen, while the tube walls phosphoresced with a very brilliant ruby-red light. A photograph of the spectrum showed the line and band spectra of oxygen, together with many carbon lines, the pair of double lines in the region \$2850 being especially prominent. On continuing the pumping and excitation for an hour the oxygen spectrum faded away, followed by the carbon lines, until only the double pair remained, at least with moderate exposures. The red phosphorescence was present with tubes of soft glass, pyrex glass, and fused quartz.

A similar red phosphorescence has been noticed by one of us during an investigation of the hydrogen spectrum, with a very long tube, brought to the 'white-stage' (that is, with the walls thoroughly dehydrated by long operation with a heavy current and continuous pumping). On exhausting to a high vacuum and admitting a little oxygen, the walls phosphoresced with a pink colour under the influence of the discharge.

Later in the summer, one of us made some further experiments with one of these tubes in collaboration with Prof. T. R. Merton at his private laboratory. The tube had been sealed from the pump in Tuxedo, and as a result of continued operation showed the red phosphorescence but feebly when excited by an oscillation of a seven-metre wave-length. On substituting an oscillator giving a thirty-metre wave we obtained a fairly strong red glow on the walls. Using

one electrode only, we found that a magnet, brought close to the walls, caused a concentration of the red glow on the near side of the tube, the deflexion of whatever caused the phosphorescence of the glass indicating negative electrons moving away from the electrode At the other end of the tube, the magnet repelled whatever caused the glow to the further wall of the tube, indicating electrons moving towards the electrode.

We believe that phosphorescence is associated in some way with the presence of positive ions of oxygen, but the exact mechanism of its production has not been ascertained. An investigation of the inner wall of the tube by polarised light, to detect possible changes in the surface layer of the glass, will be made in the near future, for it seems probable that the oxygen is derived from the silicon oxide. The carbon undoubtedly is due to vapour from stop-cock grease R W Wood A L. Loomis

The Alfred Loomis Laboratory, Tuxedo Park, NY.

#### The Fields of Force in the Atmosphere of the Sun.

On me signale une note de G Hale, insérée avec le même titre dans votre journal le 14 Mai dernier. La note est consacrée aux petites lignes noires, plus ou moins courbes, qui apparaissent tout autour des taches dans les images monochromatiques de la couche supérieure de l'hydrogène, et auxquelles Hale a donné le nom caractéristique de "Solar Vortices." On distingue le cas de la tache simple isolée et le cas de deux taches voisines ayant des polarités opposées, et formant un groupe bipolaire. Dans ce dernier cas, les lignes noires autour des deux taches rappellent parfois les lignes de force d'un barreau aimanté.

Or mon nom est cité comme attaché à une explication spéciale du solar vortex; mais l'explication qui m'est attribuée est mexacte ou insuffisante. Je suis conduit à préciser certains détails et à donner mon opinion actuelle sur tous les points soulevés par Hale et Buss dans votre journal les 14 et 28 Mai 1927.

I. Mes premières idées sur la question ont été résumées dans les Comptes rendus de l'Académie des Sciences, Paris, le 10 Janvier 1910, les 29 Mai et 6 Juin 1911. Le solar vortex n'est pas la cause du champ magnétique de la tache; il peut être simplement un effet du champ magnétique général du Soleil sur les files de gaz ionisé qui, dans les couches supérieures, se rapprochent de la tache (Evershed). On pout invoguer aussi la rotation de l'astre et le principe d'inertie. Le champ magnétique général, peut-être un peu modifié par le voisinage de la tache, est analogue au champ terrestre; sa direction est plus ou moins vers le nord et assez éloignée de la verticale. Dans ces conditions, il courbe dans le même sens les files gazeuses de deux quadrants opposés; 1 mais, dans les deux autres quadrants, il a surtout pour effet d'élever les gaz ou de les abaisser. Or ces différences se retrouvent dans la plupart des images de l'hydrogène photographiées à Meudon. D'ailleurs il faut considérer non seulement les actions aérodynamiques et électromagnétiques, mais les actions électrostatiques, qui peuvent donner un champ identique à celui d'un barreau aimanté.

Finalement, dans mon esprit, le solar vortex était un phénomène secondaire; l'attraction de la couche supérieure par la tache et la répulsion de la couche renversante avaient pour moi une importance plus grande, la cause de cette attraction et de cette

<sup>&</sup>quot;On peut objecter que la raie  $H\alpha$  de l'hydrogène est émise par l'atome neutre, mais, aux températures élevées de l'astre, l'atome passe souvent de l'état neutre à l'état ionisé, et inversement.

répulsion étant d'ailleurs mal connue, comme aussi la cause du fort champ magnétique de la tache, qui reste le fait le plus curieux et le plus énigmatique.

II. Dans ces dernières années, mes idées ont évolué Le rayonnement corpusculaire des couches solaires, longtemps ignoré ou méconnu, a une importance capitale; et plusieurs faits nouveaux m'obligent à admettre que la partie la plus intense de ce rayonnement est émise par des corps radioactifs. Dans les couches solaires successives, les deux rayonnements, ondulatoire et corpusculaire, se substituent l'un à l'autre incessamment; mais le rayonnement corpusculaire, beaucoup plus absorbable, est vite airêté, et la terre en reçoit seulement une petite partie, qui produit nos aurores polaires (Carl Stormer) et les orages magnétiques simultanés.

La petite aiguille aimantée apparaît ainsi extrêmement précieuse, puisqu'elle nous révèle un rayonne-ment nouveau de l'astre. A Meudon, nous enregistrons ses variations sur un papier sensible qui noircit sans développement, et l'astronome a sous les yeux les pointes de la courbe de déclinaison, au moment même où elles se produsent. De plus on prend comme horloge le Soleil qui tourne; et la pointe est représentée dans le temps par la longitude du centre du Soleil au même moment Or on constate que les pointes des orages magnétiques sont séparées, en longitude, par des intervalles qui sont des multiples de 60°, 30°, et 15°. Un certain ordre apparaît là où la confusion était d'abord la note dominante, J'ai présenté ce résultat comme un fait d'expérience dans votre journal le 30 Octobre 1926. Le Dr Chree, il est vrai, a fait quelques objections; mais j'estime qu'elles sont écartées dans les deux notes que j'ai publiées ultérieurement aux Comptes rendus le 26 Décembre 1926 et le 4 Juillet 1927.

Finalement, tout se passe comme si le rayonnement corpusculaire de nos orages émane d'une couche solaire profonde qui tourne comme un corps solide; et cette couche offre au moins 24 volcans permanents. répartis uniformément autour de l'axe de rotation, et d'activité variable, qui rejettent au dehors la matière ionisée ou radioactive des masses intérieures. Cette division régulière est celle des corps à symétrie circulaire qui se refroidissent. Cependant, les particules rejetées par les divers volcans ont à peu près les mêmes vitesses, exactement comme si elles étaient émises par les mêmes corps radioactifs. De plus les recherches poursuivies à Meudon depuis 1925 par Mlle Maracineanu ont montré que le rayonnement solaire peut modifier ou provoquer la radioactivité dans les corps (uranium, plomb, curvre); il doit avoir à un plus haut degré la même propriété dans le Soleil lui-même. Il est donc légitime d'admettre que les volcans solaires rejettent des corps radioactufs.

Le rayonnement corpusculaire de la couche profonde a été présenté par moi dès le début comme la cause première de tous les phénomènes (taches, facules, filaments, protubérances) observés sur le Soleil et ses dépendances. Si les corps radioactifs interviennent, plusieurs faits singuliers s'expliquent aisément.3 Chaque corps radioactif se décompose en donnant naissance à un autre corps, le plus souvent aussi radioactif; il est caractérisé par sa période et la nature de son rayonnement ( $\alpha$  ou  $\beta$  ou  $\beta\gamma$ ). Si la période est courte, le phénomène est vraiment explosif, et on a d'une part un orage à commencement soudain, et d'autre part les points brillants des protubérances éruptives, qui émettent des jets

lumineux dans plusieurs directions. Lorsque le volcan rejette un corps à particules s et un corps à particules a, un groupe bipolaire de deux taches se forme, les particules s'élèvent pendant que les corps radio-actifs s'abaissent. Le champ magnetique général du Soleil déplace les deux corps dans des directions opposées et les sépare; de plus les deux corps forment avec leurs particules deux courants électriques, paralleles et de sens opposé, qui donc se repoussent Plus tard, lorsque le rayonnement a diminué, les deux corps, qui ont des charges électriques opposées et croissantes, s'attirent.4 corps donne une tache lorsque l'énergie des particules émises par elle atteint un certain niveau, les deux taches pouvant naître et disparaître à des moments différents. Les particules qui s'élèvent en s'écartant repoussent les gaz de la couche renversante, et donnent naissance aux petits filaments de la pénombre, dirigés vers le centre de la tache.6 On retrouve tous les détails de l'observation.

Le champ magnétique élevé des deux taches et aussi l'opposition de leurs polarités sont plus difficiles à expliquer, comme aussi la température plus basse de la tache, au moms lorsqu'on n'a pas recours à de gros tourbillons, dont la cause première nous échappe; mais la place manque ici pour exposer tous les points de la question. Je remarquerai seulement que cette étude des orages magnétiques conduit à des idées nouvelles sur la constitution du Soleil.

III. Dans sa note, Hale expose quelques résultats obtenus avec son nouvel appareil, le spectrohélioscope, qui est difficile à réaliser, et lui fait certainement honneur L'appareil décèle, quoique d'une manière indirecte, les mouvements radiaux qui échappent au spectrohéliographe; il a été employé à la reconnaissance de petits filaments ("long dark flocculi") animés de mouvements rapides, qui abou-tissent à une tache. Hale ajoute que le spectrohélioscope est seul capable de déceler ces phénomènes solaires qui sont fugitifs.

Cette dernière assertion me paraît exagérée. Nous avons à Meudon, à côté des spectrohéliographes, des spectroenregistreurs des vitesses, qui, en service depuis 22 ans, ont décelé souvent des phénomènes analogues à ceux décrits par Hale. Je partage aussi l'opinion de A. Buss, qui annonce avoir observé souvent les mêmes faits avec le spectroscope ordinaire A ce sujet je remarque que, en 1892-1894, le simple spectrographe a reconnu les propriétés générales des vapeurs enregistrées par le spectrohéliographe, et qu'il a révélé seul leur position exacte dans le Soleil ; l'épreuve du spectrohéliographe est l'image de la chromosphère entière.

En fait, pour les phénomènes étudiés récemment par Hale, ce qui importe, ce n'est pas tant l'appareil que la continuité de l'observation. L'astronome solaire, avec les appareils simples qui sont un spectroscope à réseau et une boussole disposée comme cidessus, fera des observations très utiles, en particulier sur les phénomènes fugitifs, s'il a la patience de suivre le Soleil pendant de longues heures.

H. DESLANDRES. (Directeur des Observatoires de Paris et Meudon.)

<sup>4</sup> En général, le rayonnement corpusculaire est le plus fort au moment où le corps radioactif est rejeté par le volcan solaire. Les taches et facules, d'autre part, ont un rayonnement corpusculaire plus faible, et les points ordinaires de la surface un rayonnement encore plus faible. D'où les différents effets observés avec l'aiguille aimantée, lorsqu'un volcan et une tache traversent le méridien central de l'astre.

<sup>3</sup> D'après cette explication, les deux taches du groupe bipolaire peuvent avoir des différences dans leurs spectres, et la durée de la tache est liée à la période de ses corps radioactifs.

<sup>6</sup> La répulsion de la couche renversante implique un tourbillon cellulaire, déjà admis par moi en 1910, adopté aussi par Bjerknes en 1926; un autre tourbillon cellulaire, superposé et de rotation contraire, correspond à l'attraction des gaz de la couche supérieure.

le 25 Août.

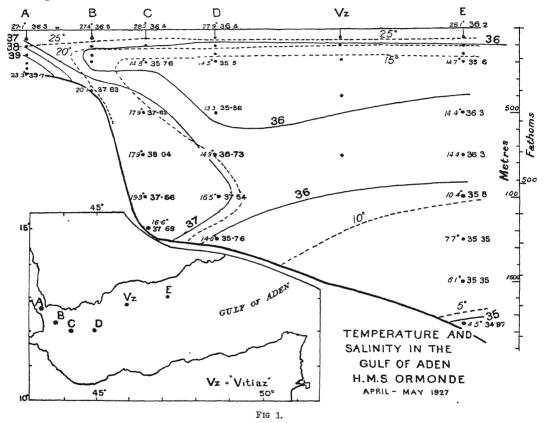
<sup>&</sup>lt;sup>3</sup> Dans sa critique, le Dr Chree considère seulement la période qui correspond à 60° de longitude; mais. dès le mois de Mai 1926, l'ai annoncé les périodes de 30° et de 15°, aussi intéressantes que celle de 60°.
<sup>3</sup> L'intervention de corps radioactifs a été admise aussi par Lenard

# Temperature and Salinity Observations in the Gulf of Aden.

Observations of the warm bottom current flowing out of the Red Sea have been made in the past by the surveying ships Pola, Vitiaz, and Stork in the Straits of Bab-el-Mandeb, and the abnormally high temperatures below the surface in the Arabian Sea have been attributed to this source. Advantage has now been taken of some tests of deep-sea thermometers made in April and May of this year in H.M.S. Ormonde (Commander C. W. Rice) under the direction of Rear-Admiral H. P. Douglas, Hydrographer of the Navy, to follow this outflow eastwards.

At all the positions A to E (Fig. 1) there was either

phosphorus in and off the Gulf of Aden was equivalent to 0.03 mgm of phosphorus pentoxide per litre in the upper 50 m., from 200 m. downwards it increased, reaching 0.143 mgm at 1750 m. Atkins and Harvey (Nature, Nov. 28, 1925) analysed samples collected by R.R. S. Discovery in the region between Portugal and the Canary Islands, and directed attention to the increase of phosphorus with increasing depth; they found none in the upper layers and about 0.075 mgm. at 2000–3000 m. The remainder of the special samples from the Gulf of Aden were mixed in two lots and examined for total arsenic by the Government Chemist. He found the equivalent of 0.005 mgm. per litre of arsenicous oxide in the depths 500–1750 m., but the upper 50 m. contained less



an increase in the temperature and salinity at a depth greater than 200 m., or at least a considerable decrease in their rate of fall; this probably marks the upper limit of the water containing an admixture from the Red Sea. The axis of the current was at a depth of from 750 m. to 1000 m. at A to D and at a slightly smaller depth at E. The temperature and salinity on the bottom at E in 1750 m. are such as might reasonably be expected at this depth in the open sea. The Valdivia in 1899, at practically the same position, found  $3\cdot7^\circ$  C. on the bottom, which is in close agreement if allowance is made for a depth greater by 90 m. The salinity determined at the same time,  $38\cdot47$ , has always seemed doubtful in combination with such a low temperature, and there can now be little doubt but that it is erroneous. The Vitiaz at Vz found a slight rise of temperature, which was probably due to the outflow, but her observations did not go deeper than 800 m.

The analysis of a few samples specially preserved with toluene show that the average content of

than 0.001 mgm. per litre. It appears, therefore, probable that arsenic is removed by plankton organisms much as phosphorus is

I have to thank the Admiralty for permission to publish these results.

Donald J. Matthews.

The Admiralty, S.W.1, Aug. 31.

#### Imperial Science Services.

In the leading article in Nature of Sept. 17 in relation to the Imperial Agricultural Conference, it is pointed out that in some branches of science there is "a lamentable deficiency" of young men coming forward to take up research. Special reference is made to research in genetics, but the statement applies to most branches of applied biology. Whilst such positions as are available in the British Isles are eagerly sought, those in tropical colonies, and to a less extent in the Dominions, are not generally attractive to university graduates in biology.

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It appears to me that the main reasons for this state of affairs are—first, that biologists in such posts are largely isolated and lose touch with progress in their science; and, secondly, that once they have embarked on such a career they have little prospect of returning to a good position at home—This second reason is obviously partly due to the first, but it is largely also due to the fact that men in the Dominions and Colonies rarely get the chance of applying for the vacancies that occur in the British Isles. Such vacancies are usually advertised in the leading English papers and in Nature, but by the time these papers reach readers in the more distant Colonies and Dominions, the date for sending in applications has usually passed.

For example, forty-four posts of various kinds in the British Isles were advertised in Nature in July and August this year. I find that the average length of time from the first appearance of the advertisement to the latest date for receiving applications was twenty-one days. The period varied from three to fifty-nine days, but in only ten of the forty-four was it greater than four weeks. It seems obvious that most of those responsible for fixing the terms of application for scientific posts in Great Britain have

not yet learnt to think imperially.

Positions in Government departm

Positions in Government departments and official institutions in the Dominions are generally only advertised locally. For example, in two of the Australian States the position of Government Entomologist recently became vacant, and in each case was filled after advertisement only in Australian papers Probably there were numerous entomologists in India and the tropical Colonies who would have applied for these positions if they had had the opportunity

The recent Colonial Conference recommended the formation of a Colonial Agricultural Research Service directed by a Council, one of the functions of which would be "the organisation of a 'pool' of scientific workers'.' The pool would probably be more attractive to such workers if a channel is constructed from it leading to positions in the home country and the Dominions. Experience in the tropics has obvious attractions for young biologists, but after a time they naturally look for positions in temperate climates where they can make homes and bring up their families. The proposed Council might perhaps act for members of the research service in the same way as the employment bureaux of our universities act for their graduates, by helping them to find such positions. The disadvantage to the Colonial Service which would result from the loss of more of its best workers would probably be more than compensated by the increased attractiveness of the Service which would result from such a policy, and the Empire as a whole would certainly benefit by it.

At the present time, when official appointments are made, preference is given to candidates with records of service in the War. In future, perhaps we may see advertisements announcing that preference will be given to candidates who have served in other parts

of the Empire.

The Colonial Conference also recommended that the proposed Council should act as "a clearing house for information". The problems of the Empire are similar to those of other parts of the world, so that the necessity of a special imperial bureau of information seems scarcely apparent in view of the existence of the International Institute of Agriculture, which is "a clearing house for information" for the world. At the present time the number of research workers in the British Empire who regularly see the abstracts prepared by the International Institute is probably only a very small proportion of the whole. They

should surely be supplied to every agricultural research station. At present they are generally to be tound only in the central libraries in the capital cities.

Abstracts are of course chiefly valuable to a research worker as a guide to publications bearing on the problems which he is investigating. Some organisation for supplying him with copies of the papers he desires to consult would be of great benefit to the isolated worker, who cannot afford to subscribe to a large number of journals on the chance of seeing papers of interest to him. An Imperial organisation for this purpose should surely receive the support of all the Governments of the Empire.

W B. ALEXANDER.

Croydon, Sept 26

#### An Unusual Case of a Natural Graft.

Some months ago a large elm tree (*Ulmus campestrus*) growing on the grounds of this station was blown down. When it was being sawn into blocks recently an interesting structure was observed. This was so unusual as to be considered worthy of notice.

The diameter of the tree was about three feet, and, judging by the number of annual rings, the age of the tree was in the region of one hundred and twenty years. At a point in the middle of the trunk and about four feet from the ground a distinct cavity was noticed. On careful examination it was found to be a definite air-space. On either side was a protoxylem area—what is technically called a crown. The accompanying photograph (Fig. 1) illustrates the appearance of the trunk, where there were two distinct protoxylem areas.

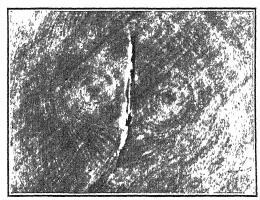


Fig. 1—Two similar 'crowns' and a bark-lined enclosed cavity within the trunk of an elm tree

The distance between the crowns was roughly five inches, and the width of the slit was less than a quarter of an inch; its length at the longest portion was ten inches, and it extended some two feet vertically in the trunk. There were fifteen annual rings between each of the crowns and the cavity. Above and below that region the stem was quite normal.

The cavity was lined with bark which had retained

its normal appearance.

What appeared to have happened was that the tree, while still young, had, for some reason, forked equally, perhaps the terminal bud had been injured and the two forks had grown apart for some years until each was fifteen years old. Previous to this something had caused the two forks to anastomose, and the subsequent growth of the tree had enabled the cambial activity to form a solid xylem cylinder round the portions of the two forks which had not fused together. So far as one could judge, great pressure had been brought to bear on the inner

halves of the two forks, since the enclosed portions of the bark were, as can be seen in the illustration, quite straightened out. There remained only a thin lens-shaped cavity in the middle of the trunk. This cavity was lined, as has been noted, with bark, which had preserved its structure during the hundred odd years it had been enclosed. The sap-wood immediately below this bark had long since lost its function, and had assumed the appearance and, presumably, also the properties of the heart-wood

Nothing can be found regarding the history of the tree, and it would be interesting if any readers of NATURE could suggest how the rejoining of the forks came about, if that be what happened. There was nothing to suggest that it had been brought about artificially.

JOHN CALDWELL.

The Scottish Plant Breeding Station, Craig's House, Corstorphine, Midlothian, Sept. 1.

#### X-Ray Diffraction in Liquids.

The experimental studies described in a previous note in Nature (April 23, p. 601) have been continued by one of us (C. M. Sogani) and the structure of some thirty-five liquids has been studied by X-radiation. The present note indicates briefly some of the outstanding results of the investigation.

The twenty aromatic liquids examined indicate a remarkable variation of the structure of the diffraction halo with the form, position, and mass of the substituent groups which replace the hydrogen atoms in benzene. Ortho-, para- and meta-compounds are

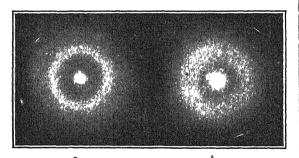


Fig. 1.—Diffraction haloes a. Amiline, b Nitrobenzene

readily distinguished by their X-ray liquid haloes. When the benzene ring is loaded in an unsymmetrical manner, there is a broadening of the halo, which is the more striking the heavier the mass of the substituent group. The research furnishes numerous examples of this effect, a striking illustration being the difference in the haloes due to aniline and nitrobenzene respectively (Fig. 1 (a) and (b)). In several of the liquids, the halo becomes doubled, a good example being that of mesitylene, where the two rings are of nearly equal intensity.

The aliphatic liquids examined include several of the paraffins, some alcohols, and an extended series of the fatty acids ranging from formic acid up to brassidic acid, which has a chain of 22 carbon atoms. The results confirm the prediction of Raman and Ramanathan (Proc. Ind. Ass. Cult. Sc., vol. 8, p. 154; 1923) that with such asymmetrical molecules, we may have more than one halo, the sizes of which correspond to different special configurations of neighbouring molecules relatively to each other in the liquids. The most striking illustrations of this are furnished by acetic acid and glycerine, each of which gives two haloes, corresponding respectively to the mean distance between neighbouring molecules

which he side by side and those which lie end to end. With very long molecules, however, only the former type of halo appears on the plates, and its size, as expected, is found to be independent of the length of the carbon chain. With the earlier members of the aliphatic series, noticeable variations appear both in the size and the character of the halo with increasing length of the chain.

The case of liquid mercury, which has also been examined, is of great interest in view of the monatomic character of its molecules, and also in view of the theoretical proof by Raman and Ramanathan (loc. cit; 1923) that the X-ray scattering by liquids at small angles would be determined by the compressibility of the liquid. Mercury has the smallest compressibility of all known liquids (3 9 × 10<sup>-12</sup>), and in agreement with the theory of Raman and Ramanathan, it is found to give a halo with a sharply defined inner margin and a very clear space within.

Further details will be found in papers appearing in the *Indian Journal of Physics*. C. V. RAMAN. C. M. SOGANI.

210 Bowbazar Street, Calcutta, Aug 25

# The Influence of Insoluble Materials on the Physical Properties of Liquids.

BAKER in his recent presidential address before the Chemical Society (Jour. Chem. Soc., 131, 949; 1927) directed attention to some interesting observations on the changes in the vapour pressure and the surface tension of a number of liquids brought about by the presence of insoluble foreign materials. Charcoal, thoria, platinum black, and finely divided nickel, materials already well known for their power of catalysing chemical reactions, were used, and he found that they brought about a change in vapour pressure, increasing with time to a constant value and, furthermore, that whilst heating increased and cooling diminished this difference it gradually returned to the original maximum. Baker attributed these changes to alterations in the complexity of the molecular association of the liquid with the establishment, eventually, of a new equilibrium. It appeared to the present writers that any change in the degree of association must necessarily be accompanied by a more or less corresponding alteration in the density of the liquid, and it seemed to be desirable to apply the delicate method of density determination now available (Robinson and Smith, ibid., 129, 1262; 1926) to the elucidation of this question.

As a result of the preliminary experiments of this investigation, in which water and ethyl ether were used, it appears to be established that considerable alteration in density occurs when these liquids, at 15°-20°, are brought into contact severally with catalysts. The density of water at about 14°·1 in contact with carbon was found steadily to increase,  $+0\,000080$  in 48 hours,  $+0\,00019$  in 96 hours,  $+0\,00020$  in 150 hours, at which value it appeared to be constant. With ethyl ether and carbon, changes of greater magnitude were recorded, the increase in density at about  $14^{\circ} \cdot 8$  being in this case +0.0009 in 18 hours, +0.0011 in 42 hours, and +0.0013 in 90 hours, this value being the same after 130 hours. Water at about 18° 5 m contact with thoria showed first a depression of -0.00017 after 24 hours, -0.00002after 48 hours, followed by an increase above normal density of +0.00001, after 96 hours, +0.00011 after 192 hours, and +0.00015 after 209 hours. It is interesting to note that with this catalyst the change m density at about 23°3 showed a much greater initial drop, namely -0 00040 after 24 hours, while the final increase above normal density after 209 hours was only  $\pm 0\,00004$ . The actual change in density between the first and last reading was, however, approximately the same, namely,  $\pm 0\,00032$  and  $\pm 0\,00044$  respectively.

Further work on this subject with other liquids in contact with a variety of surfaces is being actively undertaken and will form the subject matter of a detailed communication to be published elsewhere, meanwhile it seemed to be desuable that these results, substantiating as they do those of Baker, should be briefly indicated

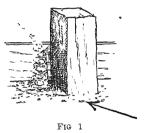
J B PEEL.

J B PEEL.
P. L. ROBINSON.
H. C. SMITH

University of Durham, Armstrong College, Newcastle-upon-Tyne, Sept. 10.

#### Water-spouts and Tornadoes.

When at Frinton recently I was interested to notice a series of whirls like water spouts on a small scale forming on the beach. The smooth, sandy beach at Frinton is protected by a series of low wooden groynes consisting of planks supported at intervals by posts some nine inches square driven into the sand. The planks rise to about a foot above the sand and the posts project somewhat more, as shown in the sketch (Fig. 1) The wind



was blowing up the beach slantwise to the groynes in the direction of the arrow, and in the corner between each post and groyne a perfect little tornado or water-spout was formed. The breaking waves were throwing up foam which was trapped in the shallow pools behind the posts, and this foam was whirled round and lifted into the air by the eddy, the foam thrown by each successive wave being quickly carried away over the groyne. Thus far the phenomena described scarcely call for comment, as the wind blowing round the post would, naturally, cause an eddy in the corner, but the remarkable fact was that the eddies were of such violence that not only foam but drops of water were lifted and, at times, a raised cone of water was visible in the centre which appeared to be at least \frac{1}{2}-inch high. Where did the suction come from?

An outstanding problem connected with waterspouts and tornadoes is the means by which the suction is maintained at the top. The centrifugal force will prevent inflow at the sides, but the whirl cannot be endless, and it has always been a matter for conjecture why air does not flow in from the end and destroy the eddy. Mr. F. J. W. Whipple some years ago suggested that cloud pendants, a similar type of phenomenon, might always occur in pairs, each pair being joined above the clouds and forming a single vortex both ends of which rested on the ground. There seems some difficulty in accepting this view, and the miniature water spouts at Frinton were certainly each self-contained. It is very difficult to see what force at the top balanced the suction, which was clearly shown at the bottom by the raised cone of water. The wind was of Beaufort force 4 or

perhaps 5, it can scarcely have exceeded 15 miles per hour just above the surface of the sand. If this wind passed over an orifice of the most favourable shape it could not produce a suction equal to \(\frac{1}{2}\)-inch of water. The matter might repay further study at Frinton or elsewhere.

Frinton or elsewhere.

Mr. W. Hayes, of the Meteorological Office, has kindly made from my description of the occurrence the sketch which illustrates this letter.

J. S. DINES.

78 Denbigh Street, S.W.1, Sept. 15.

# Early Experiments on Ultra-Filtration.

A PAPER by Wilibald Schmidt, entitled 'Experiments on the Velocity of Filtration of Different Liquids through Animal Membranes" (Ann. der Phys. u. Chem. 99, p. 337; 1856), records an observation which appears to have escaped the historians of colloid chemistry.

The author states that the concentration of the filtrate was compared with that of the original liquid and was found to agree with it when the solutions filtered contained sugar or salts. He then continues: "A different behaviour was shown by solutions of gum arabic and of white of egg. which gave perceptibly less concentrated filtrates, although the solutions had previously been filtered; the former repeatedly through linen, the latter through paper."

This demonstration that an animal membrane is

This demonstration that an animal membrane is much less permeable to colloids than to sugar or salts antedates. Thomas Graham's papers on dialysis by five or six years. Schmidt's procedure, however, is really what is now called ultra-filtration, namely, the separation of colloid particles from the dispersion medium by means of a suitable septum, generally a gel (C. J. Martin, 1896).

Schmidt did not follow up his observation, but confined himself to studying the rate of filtration of true solutions with the view of testing whether it agreed with Poiseuille's law EMIL HATSCHEK.

10 Nottingham Mansions. Nottingham Street, W.1. Sept. 24.

#### The Sources of Supply of Vitamins A and D.

Messrs Rosenheim and Webster, in their very interesting letter to Nature of Sept 24, have suggested that it should be possible to make margarine into "a perfect biological substitute for butter" by incorporation of a suitable content of the vitamins A and D. It would appear from this communication and from other recently published statements that it is not generally known that this problem has actually been solved, and that to-day it is possible to purchase margarine containing regular and uniform quantities of both vitamins of the same order as the quantities found in butter

Researches carried out in our laboratories have led to the development of a large-scale method of obtaining from cod-liver oil a palatable extract containing in highly concentrated form the vitamins A and D, and it has been found possible to incorporate this concentrate in margarine without loss of vitamin efficiency. The potency of the concentrate has been established by colorimetric and biological tests, and extensive feeding trials have shown the vitamin margarine to be equal to butter in its power to promote calcification and restore growth in rats fed on a deficient diet. We shall be glad to send samples of these products to any scientific worker who may be interested in the subject.

P. W. Tainsh.

Research Laboratories, Port Sunlight.

# Metallurgical Photomicrographic Apparatus.

AS a result of the important advances that have been made in Great Britain in the design and production of optical elements for the microscope, it may be claimed that microscope lenses are now being made in England equal, if not superior to, any made abroad The excellence of an optical instrument such as the microscope depends, however, not on the perfection of its optical elements alone. Mechanical arrangements must be provided by means of which these elements may be held in definite relation to one another without shake and be capable of adjustment in a manner which is It is well known, for convenient to the user example, that any lack of true centration in the optical parts or of perfect alignment in the optic axis of these parts produces more serious deterioration in the resulting micro-image than does almost any other single factor. The possibility of such deterioration can largely be prevented by proper attention to the details of mechanical construction and design.

An examination of four modern types of metallurgical photomicrographic outfits at present in use, three of British and one of Continental manufacture, gives examples of the variations in construction and design adopted by different manufacturers in their attempts to fulfil the mechanical requirements. In each case the various parts are supported in such a way as to be capable of moving along an optical bench In the instrument by R. and J. Beck, Ltd, and also in that by James Swift and Son, Ltd., this bench consists of an elongated triangular prism machined on its two upper V-shaped saddles, carrying the various optical fittings, slide on this prism If the inner surfaces of the V were machined so as to make accurate contact with the corresponding slide surfaces of the triangular bar at every part of its length, freedom of movement of the saddle along the prism and accuracy of adjustment might be obtained. It is, however, impossible to machine these surfaces to the required degree of accuracy to avoid shake. A certain manufacturing tolerance is necessary both on the angle of the V and on the angle of the prism. A deviation from the geometrical form is thus produced, and consequently, when the saddles are clamped, rocking or rotation takes place and the alignment is disturbed. is thus impossible on such a bench to make the accurate adjustment necessary in an optical system designed for critical work.

These defects would not occur if kinematical contacts were adopted instead of plane sliding surfaces. This system, the advantages of which have for long been recognised in theory, has been adopted by some of the most progressive manufacturers of scientific instruments; but its adoption in microscope manufacture has not been effected on any large scale. In accordance with the system the correct method of designing the saddle is, as has been suggested by Prof. Alan Pollard, to allow it to make contact at three points on one surface, and at two points on the other sur-

face, of the slide. This restricts the freedom of movement of the saddle to that of sliding along the length of the bench. If the last two points make contact along a line parallel to the axis of the slide, the saddle will automatically fit the bench not-withstanding slight inaccuracies in its machining. With such a saddle no alteration of its position is produced as a result of its being clamped to the bench

In the Continental apparatus referred to above, which is made by Reichert of Vienna, the essential part of the optical bench consists of an openwork metal girder, in bridge form, suitably webbed to secure rigidity The girder is supported at each end and fitted with four levelling screws. Along the whole length of the upper surface at one edge is a plane machined surface The upper edge parallel to this is triangular in section with machined The base of the stands carrying the optical parts have, at one side, a V-shaped groove which fits into the triangular prism of the bench and, at the other, a plane machined surface which slides on the flat machined surface of the girder. A bench of this design, though not perfect, represents an improvement on the triangular bench of the other instruments There is a span of about 4 inches between the centre of the V and that of the plane sliding surface of the base of the carriers, and thus any displacement of the optical elements due to inaccuracies in the machining of the surfaces is considerably less than in the case of the single triangular bar.

In the fourth apparatus, made by W. Watson and Sons, Ltd., the optical bench consists of two metal tubes, cylindrical in section and supported on three brackets. The carrying-pieces rest on these bars, which make contact with the sides of two V-shaped machined grooves in the lower surface of the base of the carriers. In order to ensure accurate adjustment in this case, not only must the grooves be accurately machined, but also the tubes must remain definitely parallel and in one plane. This condition is not easily maintained when the apparatus is in use.

The microscope in each of the outfits examined was of the Le Chatelier type, which is now so frequently used for metallurgical purposes. The object-glass points upwards and is immediately below the stage on which the specimen is placed. In the Beck and the Swift instruments the rack which supports the stage is directly fixed on one side of the stage. The weight of the overhanging stage and of the object placed upon it thus tends to produce a sagging of the rack. The longer the instrument is in use, the greater does this sagging effect become, more particularly if heavy specimens are placed on the stage. The tilting of the stage renders it impossible to focus the whole of the field. This tendency for the stage to tilt is avoided in the Watson instrument by having the stage supported by four upright tubes fixed to a plate centrally mounted above the rack which, however, is placed at one side of the upright pillar. The Continental instrument has the rack cut on one side of a triangular pillar fitted centrally in the saddle-piece resting on the girder. The stage is supported from this pillar by three uprights, one of which is divided in order to permit of the insertion of the visual observation tube. This design tends to reduce the sagging of the rack and obviates any tilting of the stage.

In the last-mentioned instrument, and also in the Beck and the Watson, the fine-focussing adjustment actuates the object-glass and is independent of the coarse adjustment and therefore unaffected by the weight of the stage or of any object placed on the stage. In bringing an object on the stage into view, microscope users generally can tell how far they are from the actual image by the appearance of the light in the field of view In order, however, to facilitate this preliminary adjustment, the Continental instrument is provided with a scale fixed to the pıllar with graduations indicating the position to which the stage must be lowered in order to bring the object into focus for an objectglass of a particular focal length This is an instance of the addition of a device which in use may effect a considerable saving of time on the part of

The illuminating tube of this instrument contains the iris diaphragm, the condensing lens system. and a rotary disc having apertures of different sizes by means of which the intensity of the light may be varied. The condensing lens system is capable of being easily moved along the tube, the positions being marked for the two types of illuminators. Slots are provided in the tube for the insertion of coloured glass or a filter-cell illuminating apparatus, with the exception of the lamp, is thus self-contained and the tube is rigidly fixed in relation to the stage In each of the other instruments the illuminating system is fitted on a separate small optical bench, rectangular in section, supported on a saddle-piece on the main bench. Each item is mounted separately and, while this may permit of greater flexibility, there is at the same time greater possibility of lack of alignment and more trouble in attaining accurate adjustment

The camera supplied with the Reichert outfit is provided with a reflex focussing arrangement by means of which the rays can be deflected on to a focussing screen at the side of the camera. This enables the operator to control the image on the focussing screen from his seat at the microscope. An observation lens carried on a bracket on the camera-stand permits of the image being conveniently examined as a whole. In the Beck instrument the image to be photographed can be projected on to a special white disc. method has the disadvantage that the room must he dark if the image is to be properly examined Better definition of detail can be seen, however, on the white disc than on the ground-glass screen.

Since the study of the macrostructure of metals is now demanding considerable attention, it is very convenient if the camera of the photomicrographic outfit can be used for this purpose. Photographs

under low magnification are frequently required of, for example, fractures, groups of flaws, very coarse structures, segregated areas, or of large crystals in ingot sections. The Reichert apparatus is the only one of the four referred to above which has a complete arrangement for macrophotography as an integral part of the apparatus The illuminating system is mounted on a small horizontal prismatic bar pivoted at the back of the optical bench. The object is placed on a small pivoted swing-out stage which can be tilted and adjusted for height. The surface to be photographed can be either in a vertical or in a horizontal position In the former case either direct or oblique illumination may be used, focussing being effected by rack and pinion adjustment of the front of the In the latter case the image is focussed by vertical adjustment of the object stage. The light is directed obliquely on to the object by means of a mirror, the rays which produce the image being deflected into the objective by a prism attached to it. These macrophotographic appliances are always in position ready for use and can easily be brought into operation at any moment instead of the camera.

The four instruments differ in other details, to some of which the user may attach importance because they suit the particular method of working that he adopts There are also certain accessories which may be fitted as additions to the various instruments for different purposes The essential differences between the four instruments have, however, been mentioned The V-and-plane type of optical bench of the Reichert apparatus offers greater possibility of accurate adjustment of the optical parts than does the triangular bar or the parallel bar type of bench used in the other instru-The mounting of the elements of the illuminating system separately as in the three British instruments provides a wide range of adjustment, but objection may be offered to the method of mounting them on a bar that is rectangular in section The design of the coarseadjustment rack in the Reichert instrument, as compared with that of the other instruments, is such as to minimise the danger of tilting of the stage when in use. The Reichert apparatus has the additional advantage that the mirror arrangement and the magnifying lens for the examination of the image to be photographed, and also the auxiliary appliances for macrophotographic work, form an integral part of the main apparatus would thus seem from the above considerations that, of the four instruments examined, the Reichert apparatus is the most complete and most nearly meets the requirements as regards mechanical design.

The prospective purchaser of a metallurgical photomicrographic outfit will obviously seek for that type of apparatus which will enable him not only to obtain the best possible results from the optical elements at his disposal, but also to obtain these results with the minimum expenditure of time and effort. The efficient production of such an apparatus involves a thorough familiarity with

the art of photography as applied to metals; a capacity for devising mechanical methods which simplify the process of taking a photograph of a metal section; a knowledge of the principles of scientific design and the ability to apply these principles in the mechanical devices employed, and the use of modern methods of precision manufacture and inspection. This obviously involves team work—the co-operation of user and producer. On the latter rests the responsibility for ensuring that the resulting instrument is sound in construc-

tion and design Sound construction requires the application of the best methods of gauging and inspection of the manufactured components. Intelligent design from the manufacturing point of view tends to reduce to a minimum these costly processes, from the user's point of view it aims at ease in manipulation and efficiency in operation. These are all essential factors in the building of an instrument that is to give entire satisfaction to the user or to find a foremost place in either the home or the foreign market.

# Standards of Book Selection in Science and Technology.1

By Sir RICHARD GREGORY

IN these days of minute specialisation in science and technology, and of a multitude of books, both general and specific, the problem of selecting the most worthy and suitable works for a library is so difficult that some librarians give it up in despair, while others are content with a solution of it which satisfies their needs and yet does not conform to any particular postulates or propositions bearing upon the principles of selection. As a matter of fact, there are no definite or accepted standards by which the worth of such books can be accurately measured, but the same comment might reasonably be made of works in any other branch of literature — fiction, art, history — with which libraries are concerned. Of the thousands of works of fiction published, what determines their admission to or exclusion from the shelves of public or other libraries? Chiefly the reputation or authority of the authors. So it must be with books on science and technology. When an author is known to have devoted particular attention to the subject of his book, then the work is obviously one to be given serious consideration A careful compilation may be just as useful an addition to a library, but it cannot have the same authority and therefore belongs to a different category.

There still remains, however, the practical problem of deciding what books are by original authorities and what by writers without the particular knowledge which gives distinction to a scientific or technical book. What librarians would probably like is a monthly list in which such books were grouped in classes of say A, B, and C, according to their importance, but the difficulties in producing such a list are almost insuperable. Failing this, such a list as the "Technical Book Review Index," issued quarterly by the Technology Department of the Carnegie Library of Pittsburgh, provides a most helpful guide to the selection of books on pure and applied science. The Index is arranged in alphabetical order according to authors' names; and it gives extracts from reviews in scientific, technical, and trade journals expressing the scope and value of the works mentioned. It is not supposed that reviews furnish an infallible index to works of

 $^1$  Paper read at the fourth conference of the Association of Special Libraries and Information Bureaux at Cambridge on Sept. 25.

outstanding importance, but they do provide a practicable source of information, and a useful purpose is served by bringing them together, as is done in the "Index" of the Carnegie Library

The recent "Report on Public Libraries in England and Wales" recognises that good and necessary books declare themselves slowly, and that there is an insufficiency of competent critics to help the librarian in his task. The Public Libraries Committee says in this Report

Attempts to provide a guide for book selection for librarians, some fairly good, have from time to time been made, but for various reasons have failed. Possibly the task is too difficult, and consequently the present method of book selection in most libraries is and can be little better than the primitive method of trial It cannot be expected that librarians or book selection committees, however competent as literary critics, should be qualified judges of all scientific and technical publications, and reliable reviews of these are usually the most difficult to find and the most belated in appearance. Librarians would, we believe, welcome assistance in the choice of books by the issue of authoritative surveys of new publications by a panel of competent judges. It is, however, essential that such surveys should not be too long delayed, and it is not easy to find qualified critics who are able and willing to devote themselves to the prompt evaluation of new books. Such surveys are, however, issued by the American Library Association, and are found helpful by librarians in America.

There is no central organisation in Great Britain which affords the same kind of competent guidance in the selection of books as that given by the American Library Association, Chicago. Each month a tentative list of all books received during the previous month is sent to representative librarians, who vote on books they have personally examined, and these votes, together with references to notices of the books in leading journals and opinions from a panel of voluntary workers, are considered by a staff which reads the selected books and prepares notes upon them for subscribers to the list. In the case of new editions (especially of scientific and technical books) libraries are advised whether the alterations are sufficient to make it desirable that the older editions should be replaced by the new.

Here, then, is a system which at any rate provides a sieve by which the more substantial works

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are separated from those which pass through the The Public Libraries Committee suggests that the Carnegie United Kingdom Trust, which has done so much for library work and organisation, might very appropriately promote the establishment of a similar scheme in Great Britain, and we are sure that librarians would welcome such an experiment Another plan would be to make the Science Library at South Kensington responsible for the selection of scientific and technical books of outstanding importance. The Public Libraries Committee contemplates that this library will be the principal source on which the Central Library will depend for the supply of books needed by research students in science, and the facilities \_it possesses or could acquire for selecting the best works on science and technology might readily be made available to libraries generally.

The task of deciding what are the best books in any subject is, however, one which no individual or institution can lightly undertake. Lists alone are not sufficient, and if they are annotated then great responsibility is placed upon the judges unless the comments are purely explanatory. There must be different standards for different types of book, and no single touchstone will be sufficient to separate the gold from the baser metal in all the classes. For our present purpose we may distinguish three groups, namely (1) popular works, (2) text-books, (3) works of reference, to each of which a different standard of selection

must be applied

(1) Popular Science — Popular books on scientific and technological subjects vary from childishly simple essays to closely reasoned accounts of the most recent additions to knowledge. They may, however, be divided into two main classes distinguished both by authorship and style. One class consists of books by writers who have the literary art of attractive presentation of scientific fact or conception. They are able to state the case for atoms and electrons just as clearly as for cells and chromosomes. They are not expert witnesses but counsel having the faculty of seeing essential points and expounding them to the court. Every librarian knows the names of some authors of this type who are popular with their readers. The works are often superficial, and scientific critics may regard the treatment as unsatisfactory, yet they serve a purpose in leading readers into realms of knowledge previously unknown to them.

Between this type of popular book with its everyday vocabulary and sentimental appeal and the book by an exponent who knows his subject by first-hand experience there is usually a great gap. Few original investigators in scientific fields are capable also of presenting them in attractive and intelligible language. They use technical words and terms which convey no clear meaning to general readers, and their books are for study rather than for reading as recreation. It is impossible to set a definite standard of suitability for books of this kind or for those of the more elementary type. All that can be done is to be

guided by experience as to authors whose works are most popular with particular groups of readers.

A list of one hundred Popular Books in Science" is issued by the American Library This list was prepared by a special Association. committee of the Washington Academy of Sciences; and it gives, in addition to full bibliographic particulars, a descriptive paragraph about each book and notes upon the various groups of scientific subjects under which the books are classified. The list, though a very useful guide to sound popular works in science, is not altogether satisfactory from our point of view It certainly includes about forty English books which are available from publishers in the United States; but there are, of course, many popular scientific books which have never been taken over in this way, and these seem to have been left out of consideration.

The principles followed by the Committee in compiling the list are, however, of general application, and are stated as follows:

Would the average reader who uses a public library, after reading the book in question, read it through to the end and come back to the librarian for another on the same subject? Such a book should be included. Or would he lay it down after a little while and turn to some other kind of book as being more interesting and not return to the subject again? Such a book should not be included, however accurate, thorough, and complete it might be from the standpoint of a specialist.

It is also desirable that the book should not be professedly a text-book, nor should it be written in text-book style; that is, it must not be a book intended primarily for the seeker after information regardless of whether the information be interesting reading or not. It is perhaps needless to add that it should have been written by an author who knows his subject thoroughly and should not be so old as to

be obsolete in its facts and speculations.

(2) Books for Students — Text-books for use in school or college belong to a different category from that of popular works for general readers. Their function is not so much to inspire as to instruct, and they sacrifice the flow of language to concise and precise statements of ascertained fact and established principle. The usual standard by which a text-book is measured is that of a proximate or ultimate examination. In Great Britain a school text-book which has no relation to examination requirements has little chance of success however original it may be; indeed, it may suffer by the very originality of its qualities. A list of the best text-books in any subject, therefore, would differ according to the point of view adopted—whether that of original and stimulating treatment or that of preparation for particular examinations. There are few books of the former type and many of the latter. In the text-book field the name of an author does not carry so much weight as it does in more popular literature, and new authors are continually competing with old for first place. Each teacher or professor has his own idea as to what are the best books for his students, so that any list of text-books published by a body representing the teaching profession tends to become a list of nearly all books available, with no comments on their value

Two such lists are published, by the Science Masters' Association and the Association of Women Science Teachers respectively The lists are useful catalogues of titles of class-books and works of reference upon various branches of science, but a librarian or student wishes to know which are the best two or three books in each of the groups and neither list affords that kind of guid-In almost any usual school subject of scientific study, there are twenty or more 'best' books, and only individual preference selects one rather than another It may be doubted whether librarians should include such books on their shelves, or limit themselves to text-books of an advanced type which students may not be able to afford to purchase or which may be of service for reference

The only sound standard of school-book selection is that of successful experience, and if such books are included in a public library, probably the best plan is to communicate with teachers of science and technology in the secondary and technical schools of the district as to the books in actual use. This may be an unsatisfactory course to follow, but it is preferable to placing upon a librarian the responsibility of selecting the best text-books from scores which are equally serviceable. The tendency in school text-books is towards consideration of everyday things and away from the purely academic attitude, so that some books of this class are as acceptable to many readers as are books written in what is conceived to be a popular style

(3) Standard Works - An attempt is made to

provide a guide to what books are of value to students of science and technology in Sonnen-schein's monumental work. "The Best Books," the third edition of which appeared a few months ago. Three-quarters of the volume comes under the head of science understood in a broad sense, and there are signs by which works of outstanding importance may be distinguished from others. Such a work, however, soon gets out-of-date, and what librarians want is a periodical list in which scientific works are evaluated on a standard plan

Almost every week sees the publication of a number of books on various topics of science and technology, and to decide which are of permanent value and which negligible puts too great a strain upon the capacity of a librarian or a library committee What, for example, determines the works of reference which ought to be in a library and those which may be omitted? Every department of science and technology is now minutely specialised, and for most of the many aspects of them there are special books Probably the chief means by which the worth of these is measured are reviews in leading journals devoted to science and technology, but such notices are often long delayed, and even the best reviewers have different standards of When, however, a work is actually purchased for the library of a leading scientific or technical society, or accepted from one of its fellows, this fact provides positive evidence of its substantial quality. If, therefore, arrangements could be made to compile a monthly list of such purchases, librarians would be provided with titles of works of outstanding importance from which to select what would be most suitable for their reference shelves

### Science and Industry in Australia.

THE Council for Scientific and Industrial Research of the Commonwealth of Australia Research of the Commonwealth of Australia has decided to issue a quarterly journal which will provide a means of disseminating general information respecting Australian scientific problems and the scientific research work in progress throughout the Commonwealth. In a foreward to the first number of the new Journal of the Council for Scientific and Industrial Research 1 (August 1927), the Prime Minister (the Right Hon. S. M. Bruce) stresses the importance of making the best possible use of the relatively small personnel which is available for the scientific investigation of Australian problems. To this end, a Trust Fund of £250,000 has been created for the use of the Council during the first few years of its existence, while the interest on a further sum of £100,000 will be applied to the training of research students. particularly in the biological sciences On the manufacturing side, the co-operation of the Council with the British Department of Scientific and Industrial Research will be facilitated by the recent visit of Sir Frank Heath to Australia

<sup>1</sup> Edited by G. Lightfoot, and published by the Government Printer, Melbourne, at 5s. per annum, post tree

(NATURE, 117, 460, 697; 1926), and it is hoped that co-operation in agricultural activities will be considered at the Imperial Agricultural Research Conference being held in London this month

Sir George Pearce contributes an informative article dealing with the organisation and work of the Council, in which he summarises the progress of investigations on plant problems, irrigation settlement problems, entomological problems, animal pests and diseases, stock nutrition, forest products, the preservation and transport of foodstuffs, fuel problems, etc. In addition to this general treatment, special articles are included on "The Commonwealth and Agricultural Research" (Prof A. E. V. Richardson), "Animal Nutrition Problems" (Prof. T. B. Robertson), and "The Biological Control of Prickly Pear " (A. P. Dodd) There are also reports on co-operative research in the wool industry, and on the Australian meat industry (freezing of beef), together with notes on the investigation and eradication of poisonous plants, astronomical work in Australia, the Australian Radio Research Board, and other matters.

The enormous losses occasioned by imported plant and animal pests have shown the need of

submitting such pests to scientific control, and their investigation figures largely in the work prosecuted under the regis of the Council Public opinion in Australia is now fully alive to the economic significance of work of this kind so that even the construction of the transcontinental railway was not undertaken without the introduction of precautions against the spreading of sparrows and starlings from the eastern States into Western Australia

The most important plant problem is undoubtedly presented by the prickly pear (Opuntia), which covers some sixty million acres in Queensland and New South Wales, with an annual rate of increase of about a million acres The two mam pest pears are O inermis and O. stricta, and the remarkably rapid spread of the former species in Australia is regarded as one of the botanical wonders of the world." Eradication by mechanical or chemical methods is usually impracticable on account of the density of the growth and the low value of the infested land. Efforts have therefore been concentrated upon the application of biological control, and the striking results of introducing such American prickly pear insects as cochineal (Dactylopius tomentosus, D. indicus, and newsteadi), boring caterpillars (Cactoblastis cactorum), the prickly pear red spider (Tetranychus opuntice), plant-sucking bugs, etc , have " altered the hopeless attitude from which the control of prickly pear was formerly viewed. There is every reason to believe that, as the insects multiply and spread, the area covered by the pest will gradually diminish, and the land be reclaimed for pastoral and agricultural purposes " Researches are also in progress at the Waite Agricultural Research Institute, South Australia, on 'tomato wilt,' a disease, originating near Melbourne in 1915, which has caused great destruction in all the tomatogrowing States; while in Queensland attention is being concentrated upon two diseases ('bunchy-top' and 'squirter') which have occasioned enormous losses to growers of bananas "The major part of the investigations on bunchy-top, a disease which has practically wiped out the banana plantations in certain areas, has been completed, its cause and the means by which it is spread have been discovered, and recommendations for control have been made to the State authorities."

The development of the Murrumbidgee irrigation scheme has raised problems in connexion with citriculture, viticulture, rice-growing, etc., and these are being investigated in the research stations at Griffith and Merbein; in addition, a soil survey is being conducted under the direction of Prof. J. A. Prescott, of the Waite Institute.

The entomological work is concerned at present mainly with the grass-grub, the buffalo-fly pest, and dried-fruit pests. It is feared that the buffalo-fly, if allowed to spread, may affect the Australian cattle industry even more seriously than the cattle-tick has done; the problem of control is difficult, but a beginning has been made by collect-

ing information regarding this formidable pest from entomologists in the Dutch East Indies, the Philippines, and Hawaii. Another animal pest, of a very curious and embarrassing nature, is the 'flying fox,' a large fruit-eating bat, the depredations of which were recently described in Nature (Aug. 6, p. 189) by Prof. A C D Rivett

Investigations of forest products, which are of peculiar interest in Australia, have been directed largely towards the possibility of utilising indigenous woods in the manufacture of news-print, the annual import of which exceeds 100,000 tons. Those pioneer workers on Australian forest products, R T. Baker and H G Smith, pointed out some years ago that certain species of Eucalyptus were suitable for this purpose; recent work carried out under the auspices of the former Institute of Science and Industry, and extended by the present Council, has done much to establish the economic possibility of preparing from such sources a mechanical pulp, suitable for blending with chemical pulp of the same origin, in the production of news-print There are also prospects of utilising Australian woods as the raw material of high-grade celluloses, suitable for the manufacture of artificial silk Further, the pulp from Pinus insignis, an imported pine which grows very rapidly in Australia, has been found to lend itself particularly to the manufacture of kraft paper.

For many years it has appeared paradoxical that Australia, which is exceptionally rich in plant astringents, should import tan-bark and tannin extracts from South Africa, from the Australian point of view the paradox becomes painful when it is realised that a good deal of this imported material is derived from varieties of wattle originally cultivated in South Africa from Australian seed! It appears from the Journal that a comprehensive survey of Australian sources of tannin has been accomplished, and that a small extraction plant has been erected for the investigation of barks from suitable species of Acacia and Eucalyptus, and also from mangroves. To these should certainly be added a number of species of Callitris, notably C calcarata, which is so widely distributed on waste hilly land and 'pine ridges' throughout the eastern States of Australia. In spite of such investigations, one fears that the economic production of tannins in Australia will continue to be handicapped by the disparity between the wage accepted by South African bark-strippers and that required by the Australian 'bush-whacker' for the

The almost complete dependence of Australia on other countries for the supply of liquid fuels has led to a consideration of the low-temperature distillation of coal and shale, but on account of the general attention which is being devoted to this matter in other countries, it is not considered justifiable by the Council to undertake researches of the kind in Australia. No doubt current work on the utilisation of brown coal as a basis of liquid fuels will be followed in Australia with

equal interest. An inquiry is also being made into the reasons underlying the economic failure of the Australian shale-oil industry. Researches on the production of power alcohol are at present limited to experiments which are being conducted under the supervision of Prof. N. T. M. Wilsmore, dealing with the hydrolysis and fermentation of the commoner Australian hardwoods.

It is evident from a consideration of this interesting new publication that the Commonwealth

Council for Scientific and Industrial Research is making encouraging progress with the multifarious problems presented by this isolated and fallow land-mass of the southern hemisphere, which until recently has remained free from the disturbances and developments following in the train of permanent civilised settlement. The future record of the Council's activities should be full of interest to workers in all branches of science.

John Read.

# The Centenary of Marcelin Berthelot.

RENCH chemists will be supported by their colleagues of many nations in the forth-coming celebration of the centenary of the birth of Pierre Eugène Marcelin Berthelot, the famous Parisian chemist whose researches, particularly those dealing with thermochemistry and with the synthesis of organic compounds, were as revolutionary—rather, as evolutionary—in their effect on the aims and outlook of chemistry as those of Lavoisier.

Berthelot was born in the Place de Grève, now Place de l'Hôtel de Ville, on Oct. 25, 1827, and died, also in Paris, on Mar 18, 1907 The centenary celebrations commence on Sunday evening, Oct. 23, with a reception of the members of the official delegations in the Salons of the Sorbonne. On the following day the guests will be present at the opening of the exhibition of Berthelot souvenirs in the Faculty of Pharmacy, and will visit the savant's monument and laboratory at the Collège de France. There will follow a reception at the Hôtel de Ville, and a commemorative assembly at the Sorbonne.

On Tuesday, Oct 25, the proceedings will commence with a ceremony at the Panthéon; the delegations will also attend a banquet at the Palais de Versailles and a soirée at the Théâtre National de l'Opéra. On Wednesday, Oct. 26, the foundation-stone of the "Maison de la Chimie" will be laid, lunch will be taken at Chantilly, there will be a reception by the Institut de France, and the celebrations will terminate with a reception in the Palais de l'Élysée by the President of the French Republic. The arrangements are being made under the presidency of M. Paul Painlevé. The "Maison de la Chimie," which is to be erected in Berthelot's honour, will provide a centre at which various international committees may establish their bureaux; it is intended also to provide a library, and suitable accommodation for gatherings of an international character

Berthelot's contribution to scientific progress was amazing in its extent, marvellous in its accuracy, logical in its prosecution, clear in its expression, and far-reaching in its effects. Only in 1843, Berzelius had expressed little hope of the synthesis of more than a few exceptional organic compounds; the barrier between mineral chemistry and the chemistry of living things was still not only real, but also apparently permanent. Berthelot's synthesis of ethyl alcohol, formic acid, methane, ethylene, acetylene, and benzene de-

stroyed that barrier with a completeness which has been emphasised by the subsequent systematic architecture and construction of the wonderful edifice of synthetic organic chemistry as it exists to-day. Evidently Berthelot realised something of the proportions of that edifice when he said "Le domaine où la synthèse chimique exerce sa puissance créatrice est plus grand que celui de la nature actuellement réalisé." Out of an observation of the sluggishness of the formic acid synthesis there developed an extensive series of investigations on thermochemistry, a subject in which considerable progress had already been made by Thomsen and others; recognition of the principle of mass action can be traced to Berthelot's work on the interaction of glycerol and acids; the fixation of nitrogen interested him, and it is noteworthy that, in the face of considerable criticism, Berthelot asserted that free nitrogen could be assimilated by plants. He was also the first to ascribe this power to the activities of bacteria in the soil. In the latter half of his life, Berthelot took an active interest in public affairs. Thus, during the siege of Paris in 1870, he became president of the Scientific Committee of National Defence, an appointment which led directly to his systematic study of explosives and the theory of explosions, and to a new conception—that of the detonation wave. Later he became Minister of Public Instruction and then Minister of Foreign

The dominant aim of Berthelot's life was the discovery of truth and the service of mankind. It was fitting that the medal struck in his honour on his seventy-fifth birthday should have borne the inscription, "Pour la Patrie et la Vérité." It is quite impossible in these columns to express in any but the most general and colourless terms the debt which human progress owes to Marcelin Berthelot. Those who, without studying the great number of his original papers, desire to know more both of the man and of his work would do well to refer to Prof H. B. Dixon's Berthelot Memorial Lecture (Journal of the Chemical Society, 99, 2353; 1911), to a longer notice by M. Émile Jungfleisch (Bulletin de la Société Chimique de France, 1913, 260 pp. separately paginated), to a brief article by Prof. Camille Matignon (Chimie et Industrie, 16, 3; 1926), and to an appreciation by Dr. C Graebe (Berichte der Deutschen Chemischen Gesellschaft, 41, 4805; 1908).

# Obituary.

#### Prof Adrian Stokes

THE death of Dr Adrian Stokes, Sir William Dunn professor of pathology, of Guy's Hospital Medical School, University of London, has robbed pathology, and therefore medicine, of one who, though he had already accomplished much, had not yet reached the height of his powers, and his loss, at the early age of forty, is the more poignant because of the tragic circumstances which sur-

Adrian Stokes was the youngest son of Mr Henry John Stokes, and was born at Lausanne in 1887. There was a strong medical tradition in the family, for many of his forbears had left names to conjure with in Irish medicine. At Trinity College, Dublin, where he graduated in 1910, he early gave promise of brilliance, for he not only gained numerous academic distinctions, but he was also a keen athlete and was a worthy member of one of the strongest cricket elevens that has represented his Alma Mater.

After doing the usual house appointments, Stokes spent eight months at the Rockefeller Institute in New York, and then returned to Dublin where he joined the staff of Prof. O'Sullivan. Henceforth he devoted himself whole-heartedly to the study of pathology and bacteriology, and he had become an expert in laboratory technique when the War broke out in 1914 He at once obtained a commission in the RAM.C. and served in France throughout the War. Although actually attached to a casualty clearing station as a specialist in pathology and bacteriology, Stokes took the broadest view of his duties and responsibilities He equipped his motor cycle and sidecar with an incubator, setting up what was in effect the first mobile laboratory in France, and his work did much to restrict the incidence of typhoid fever in the early days of the War.

Of the original work which Stokes carried out during this time, his investigations into the cause and mode of transmission of spirochætal jaundice was probably the most important. He identified the spirochæte and demonstrated its presence in the bodies and urine of trench rats, a discovery which led to the suppression of what might have become a very serious epidemic. But it was not only in his own particular branch that Stokes did brilliant work. He was the inspiration of the mess in which he lived. Full of energy and ingenuity, he not only lent a hand wherever one was required, but also he tackled the problems of others and applied his knowledge of laboratory technique to solving their difficulties He kept himself up to date in the various new methods of treatment and, as soon as he was convinced of their superiority, he never rested until they had been adopted in his immediate vicinity. 'Brass hats' were to him the means of obtaining what he felt was necessary for the good of the sick, gassed and wounded, and his vehement, but clear and cogent, demands for apparatus, drugs, etc., were very rarely unsuccessful. All this he effected while maintaining his own special department at the height of efficiency. Those who served with him aver that he did more than any other single individual to improve the medical treatment of the troops and to diminish wastage.

On demobilisation in 1919, Stokes was appointed to the chair of bacteriology and preventive medicine at Trinity College, Dublin, but in 1920 he was invited by the Rockefeller Foundation, who had been greatly impressed by his work on spirochætal jaundice already mentioned, to join the West African Yellow Fever Commission It happened that during his visit to Africa very few cases of vellow fever occurred, and his work was necessarily indeterminate

In 1922, Stokes was appointed to the Sir William Dunn chair of pathology at Guy's Hospital Medical School in the University of London, which he occupied at the time of his death. He did much to improve the status of pathology in the School, and he was tireless in his efforts to arouse interest and to stimulate research Intensely practical in his teaching, he succeeded in attracting brilliant students, and, given the time, he would have created a school of pathologists keen to tackle problems whose solutions might lead to advances in medicine

In April of this year Dr. Beeuwkes, the head of the Rockefeller West African Yellow Fever Commission, asked for Stokes's help, for the problem of yellow fever in West Africa was little nearer solution than it had been in 1920. Indeed, it was still uncertain whether it was identical with the yellow fever of South America. The latter disease is carried by Stegomyia fasciata, the common domestic mosquito, and Noguchi has described a leptospira as the causative organism. Stokes obtained leave of absence from Guy's for six months and sailed for Lagos in May. He was not particularly hopeful of succeeding where others had failed, and his first letters spoke of negative results. In July the outlook was brighter, and in the middle of August he wrote that he had succeeded in transmitting the disease from the human patient to monkeys, both by blood infection and through the medium of mosquitoes. No leptospiræ had been found, and he was satisfied that the cause had not yet been isolated. He was then engaged in the microscopical examination of infected mosquitoes in serial section. "It is infuriating to know that one has the virus under one's eyes and cannot see it," he wrote at that time.

Then on Sept. 16 came a cable to say that Stokes was seriously ill He was removed that day to the European Hospital, where he died of yellow fever on Sept. 19. How he contracted the disease is not yet certain, but it would appear highly probable that he infected himself accidentally in his laboratory. Time alone can show the value of his work on the disease to which he fell a victim; but if, as appears certain, he has helped materially towards the discovery of the cause of yellow fever in West Africa, he would not have counted the cost.

In Stokes's public and private life, transparent honesty and sincerity irradiated his every word and every action . outspoken and candid, he never left any doubt as to his meaning and ' to beat about the bush 'was foreign to his nature His energy and his capacity for work were amazing, and all the more so when one remembers that his greatest enemy was insomnia, and that for him five hours As a teacher, was an unusually good night's sleep he preached the gospel of scientific truth with an earnestness born of conviction His students absorbed from him the right critical attitude towards their work, and the best of them became infected with his own zeal for research He was generous to a fault, and many a lame dog was helped over a stile without ever knowing whence his help had come. An Irishman by everything but the accident of his birthplace, he loved his country as deeply as he hated those whom he regarded as being responsible for her unhappy state, which was a source of real grief to him

Stokes died in harness, as he would have wished to die, but his premature death will be widely mourned by all who are interested in the advancement of medical knowledge, and especially by those who were privileged to come into intimate contact with a personality so vigorous, so stimulating, and so kindly

WE regret to announce the following deaths

Prof Syante August Airhenius, For Mem R.S., of the Nobel Institute, Stockholm, from which he received the Nobel prize for physics for 1903, on Oct. 2, aged sixty-eight years

Prof. Willem Emthoven, For Mem. R.S., professor of physiology in the University of Leyden, and Nobel laureate for physiology for 1924, on Sept 28, aged

sixty-seven years.

Dr George Andrews Hill, senior astronomer at the U.S Naval Observatory, Washington, on Aug 29. aged sixty-nine years

Prof. A. Liversidge, FRS, emeritus professor of chemistry in the University of Sydney, on Sept 26,

aged seventy-nine years

Dr H D Thompson, for more than thirty years professor of mathematics at Princeton University, who was known for his work on hyperelliptic functions and on geometry, aged sixty-three years.

# News and Views.

THE annual general meeting of the Australian National Research Council was held in Melbourne on Aug. 25-26. Particular attention was given to the financial position of the Council in relation to present and future work. The offer of the Carnegie Corporation to provide a sum of £5000 as the nucleus of a research fund was accepted with most cordial thanks, and with this sum and more than £1000 available from other sources, such a fund was formally insti-A strong committee was appointed to take action for securing additional contributions from Australian sources, and it is hoped that before long the Council will be in a position to give considerable aid to Australian workers in pure science Amongst several satisfactory reports on the year's work was one from the Anthropology Committee outlining the progress made since the initiation of the Department of Anthropology in the University of Sydney. step followed upon a resolution by the second Pan Pacific Science Congress of 1923 and was made possible by contributions from the Commonwealth and State Governments and the Rockefeller Foundation. The new Department is now in full swing and is taking active steps to organise investigations both on the mainland and on the neighbouring Pacific islands. The following new members were elected to the Australian National Research Council, the total membership of which may not at any time exceed 100: Mr. C. R. P. Andrews (Director of Education, Western Australia); Prof. A. R. Radcliffe Brown (Anthropology, University of Sydney); Prof. A. N. S. H. Burkitt (Anatomy, Sydney); Prof. A. J. Ewart (Botany, Melbourne); Dr. W. A. Hargreaves (Government Chemist, South Australia); Prof. J. W. Paterson, (Agriculture, Perth); and Dr. H. R. Seddon (Veterinary Research Station, New South Wales).

THE Trustees of the Commonwealth Science and Industry Endowment Fund in Australia are this year

making £1250 available in small grants for the assistance of scientific workers in Australia. which will be followed in making the grants will be similar to those which have been proved to be satisfactory by the Department of Scientific and Industrial Research in Great Britain. The Commonwealth Fund has an invested capital of £100,000, and it is provided by Act of Parliament that the interest from it shall be employed for the dual purposes of training students in the methods of scientific research and in providing assistance to persons engaged in research, irrespective of whether their work has an obvious practical application or not. At present, the income is being devoted mainly to the first object, but as time goes on it is expected that an increasing sum will be available annually for distribution in grants.

Prof. J. A Prescott, professor of agricultural chemistry at the Waite Institute, University of Adelaide, has been appointed adviser on soils problems to the Commonwealth Council for Scientific and Industrial Research. Prof. B. T. Dickson, of Macdonald College, Quebec, has been appointed chief mycologist to the Council and will take up his duties in Australia towards the end of the year.

THE interest in the relationship between science and religion, which was revived by Sir Arthur Keith's address to the British Association on the descent of man, has been further stimulated by the sermon preached by the Bishop of Birmingham in Westminster Abbey on Sept. 25, and the opinions of eminent divines thereon which have been collected by the Morning Post. As a further reaction, the Sociological Society, aiming at resolving the conflict in a higher synthesis, has arranged a series of addresses expounding the 'sociological approach' to religion in which a 'higher' science, accepting the data of a 'lower,' will deal with the religious process as a striving after a purpose which renews itself from

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generation to generation in purifying and ennobling man's life in its quest for mastery of self and the environment. The series of addresses will be opened on Oct. 18 by Sir Francis Younghusband, president of the Society, who on this and the succeeding Tuesday will deal with what is termed the 'attack' on religion and the reply, though no actual attack has been made by science. He will be followed on succeeding Tuesdays by Mr Farquharson, Dr. Saleeby, and Mr. V. Branford. The addresses will be delivered at 1.15 p. M. in All Hallows Church. Lombard Street.

THE tornado which caused so much damage and loss of life at St. Louis on Sept. 29 appears to have been a typical example of the most violent of all types of atmospheric vortex Along the narrow strip of country—generally less than a quarter of a mile wide—visited by a tornado, destruction is generally complete, for no building can withstand the enormous pressure exerted by the winds, which are believed to exceed a speed of 200 miles an hour; moreover, the reduction of statical pressure in the central core is so great that buildings, which tend to retain air at pre-existing pressure, frequently burst Tornadoes reach their fullest development in the United States, particularly in the great lowlands east and west of the central and upper Mississippi and lower Missouri valleys. They generally occur to the south or southeast of cyclonic depressions that have, extending southwards from the centre, a pronounced 'trough,' often of V shape, separating warm moist southerly winds from the Gulf of Mexico from relatively cold westerly to north-westerly winds lying farther to the west, and normally arise a little to the east of the line of discontinuity which marks the boundary on the ground between the two wind currents. The tornado is clearly due to instability of moist air. and therefore occurs most often at that time of the year when conditions are most favourable for a steep vertical gradient of temperature, or 'lapse-rate,' that is, in the spring and early summer, when solar heating is becoming powerful and yet the upper atmosphere retains much of its winter coldness; however, unlike the far larger 'tropical cyclone,' it may occur in any month St Louis was the scene of one of the most famous tornadoes of the close of last century—that of May 27, 1896—but the recent storm appears to have been the more destructive of the two

SEPTEMBER was in most parts of the British Isles an even wetter month than was August, the total rainfall in some places being three times the normal. At Kew Observatory the total was 450 inches, compared with 406 inches in August. It is interesting to note that the records of rainfall in London since 1812 show that in two previous years—1852 and 1903—a run of wet months began in June. In 1852 the last seven months of the year yielded 28 08 inches, and in 1903, 26 81 inches, whereas the normal for the whole year is between 24 and 25 inches. In neither of these years, nor in any year previous to 1927, did the combined totals for August and Sep-

tember exceed eight inches, consequently the total of 8.56 inches for the last two months is easily a 'record' since 1812

The immediate cause of the wet weather in September was the persistence of high atmospheric pressure in the neighbourhood of Greenland. This caused frequent cold north or north-east winds over the Arctic Ocean, and these encountered warm south-westerly winds brought up from low latitudes round the anticyclone between the Azores and Bermuda. Such winds carry with them much moisture especially in early autumn, and the interplay of the two currents resulted in the formation of numerous depressions, which were carried eastwards across the British Isles by the upper winds from the west that prevail in temperate latitudes when there is a steep gradient of temperature from south to north Moreover, the persistence of high pressure in the far north tended to prevent Atlantic depressions from wandering up into higher latitudes, and so allowing the Azores anticyclone to make those periodical excursions north-eastwards which are responsible for so many of our spells of dry sunny weather

On Oct. 3, the telephone service between Great Britain and Canada was opened and messages were exchanged by Mr. Baldwin and Mr Mackenzie King and by representatives of the Times in London and in Toronto. It was stated that the conversations were heard very clearly. The route taken by the signals depends at present partly on American land lines From London the signals go to Rugby by land line. whence they are transmitted by radio to Houlton, in Maine, some 600 miles from New York Houlton they go by land line to any Canadian city which is required. Canadian messages are transmitted by land line to New York, thence to Rocky Point, whence they are sent by radio to Cupar in Fifeshire. From Cupar, the signals travel by land line to London. There is no suitable radio station for the Great Britain-Canada service in Canada, and it is stated that no such station is contemplated.

CAPTAIN IAN FRASER complains, in a communication in the Times for Sept. 29, that many of the dwellers on eastern and southern seaboards of England have their broadcast reception spoiled by the Morse signals coming from ships. He does not ask that ships be forced to scrap obsolete apparatus, but he thinks that all new radio equipment for ships should be made so as to operate closely on their own wave-lengths and consequently not trespass on the band of frequencies allotted to broadcasting. It should not be difficult to obtain this by international agreement. Until recently practically all Post Office coastal stations for communicating with ships made use of synchronous spark telegraphy. The average range of stations like those at Seaforth, Fishguard, Niton, Cullercoats, and North Foreland is about 500 miles. With the spark system adopted, only 'broad' tuning is available, and consequently the waves emitted interfere seriously with users of crystal sets. The Post Office authorities are now substituting the more modern and more efficient interrupted continuous wave system of communication for the spark systems. This will be a boon to listeners-in at places like Seatorth and Cullercoats.

In the July number of Electrical Communication, a journal published by the International Standard Electric Corporation of New York, there is an instructive article on "European Telephony as affected by the International Telephone Committee." It is pointed out that the War was followed by the formation of many so-called international organisations which were, however, almost purely European. They cover a wide field of activity in commerce and industry. The organisations are concerned with railways, tramways, electric traction, sleeping cars, production and distribution of electricity, telephony, telegraphy, broadcasting, etc. The formation of these unions is attributed mainly to the idea underlying the creation of the League of Nations. In 1922, Mr. F. Gill first suggested international telephony. The outcome of this was the formation of a Comité Consultatif International—now known as the CC.I. -for organising international telephony in Europe. It was hoped that the C.C.I. would become affiliated with the League of Nations, but when the proposal was made, Germany was not a member of the League and so the C.C.I. was incorporated into the International Telegraph Union. As the Union embraces the whole world, any country can now become a member of the CC.I. on application. Mczambique and the Union of Sovietic and Socialistic Republics (U.S.S.R.) are now members. One of the main objects of the international committee is to secure uniformity of practice, but representatives of private industry are invariably consulted. The committee has also decided to establish in Paris a Master Standard Reference System, to enable the countries of Europe to standardise their telephone apparatus. Another question which has been discussed is the construction of a special type of underground cable for the purpose of interconnecting broadcasting centres in Europe. It is concluded that the C.C.I. has fulfilled and is fulfilling a useful function.

EXCEPTION has been taken by Mr. J M. Crosthwaite, secretary to the Scottish Society for the Protection of Wild Birds, to a "few misapprehensions" which he alleges appeared in a paragraph dealing with the 'death' of the Wild Birds Protection Bill, in our issue of July 23. In a letter to the editor on the subject, he repeats, amongst several criticisms of the Bill which have no bearing on the paragraph in question, the misleading statement against which the paragraph protested, that "this Bill adopted the extraordinary principle of securing protection only for rare birds," while at the same time he admits that for five months, covering the most important part of the year, the breeding season, it prohibited the taking and destroying of all wild birds. Mr. Crosthwaite considers that birds were better off without this Bill, and supports his view by statistics showing that a larger number of species is included under the present County Council orders. But the effective-

ness of the protection is more important than lists on paper, and in a matter of opinion most people will prefer to be guided by skilled naturalists and legislators, such as Viscount Grey of Fallodon, Sir Montagu Sharpe, the Council of the Royal Society for the Protection of Birds, and the experienced ornithologists who advised the Government, all of whom considered that the Bill would have protected British birds more efficiently than the present Acts Mr. Crostliwaite states that "complaints are being received of the shooting of our song birds by Italians and other aliens resident in this country." This is a matter of interest which ought to be investigated, though it is difficult to see how Italians, granted they have obtained gun licences, could deplete the song birds of the country without trespassing on private property or breaking the ordinary laws of the land

IT is curious that in Great Britain, where comparatively little timber is grown, wooden poles are nearly always used for telegraph and electric power lines In France, Germany, and other countries where forests abound, armoured concrete poles are now becoming the rule The advantages of reinforced concrete over wood poles are that they are neater in appearance, last longer, and want little attention. Perhaps one of the reasons why there are so many wooden poles in Great Britain is that timber has been expensive for many years and it is advantageous to creosote it thoroughly so as to increase its life. Wellshaped poles also are only used. In a paper by T. Rich, published in the *Electrical Review* for Sept. 23, examples are given of the concrete poles used on the Continent. One reason which may have had weight in changing from wooden poles is that abroad the timber for poles seems to have been selected norther for appearance nor durability, and little use seems to have been made of preserving processes. In connexion with power transmission lines, the periodical painting of steel lattice masts seems to be a costly item. In France, since the War, there seems to have been continuous progress in the use of concrete supports, for distribution lines and poles of this type are seen in almost every part of the country. The poles are made on the ground in the open air and are carried to their destination by lorries. Many of the electric lighting companies have the right to put up lines along the roads at a small annual fee for each pole. Concrete posts have now been in use for several years. Owing to our climate we think that they might now in many instances be used advantageously in Britain.

The September issue of The Scientific Monthly mentions a remedy devised by Dr. James Couch, U.S. Department of Agriculture, for the irritation and eruption caused by poison ivy, which might be useful against other plant irritants such as Primula obconica It consists in the free application by swabbing of a 5 per cent. solution of potassium permanganate. The resulting brown staining of the skin may be removed slowly by soap and water or quickly by the application of a 1 per cent. solution of sodium bisulphite. As a preventive of plant rashes, Dr. James M'Nair recommends the application of a lotion consisting of a 5 per cent solution of ferric chloride in a mixture of equal parts of water and glycerin. It is washed on all exposed parts and allowed to dry.

Personal exercise of the arts and crafts at home in preference to the mechanical output of the factory is to be welcomed with every sign of ardour. Therefore a hearty greeting is due to books which may aid teachers in making the young idea shoot University of London Press is issuing a Handiciaft Series (1s 6d per volume) prepared by Mr. Frederick J. Glass, whom we also know as the author of the more ambitious work upon "Drawing, Design, and Craftwork," now in its second edition. Mr Glass exhibits more than a trace of the talent of Walter Crane in his adaptation of ornament and in the style of its portrayal. It may be noted, that the diameter must, necessarily, pass through the centre (vide "Pewter Craft," p. 36), and that a circle measures more than three times its diameter in circumference (vide "Paper Craft," pp 49 and 51). In commending the general style of the text, we may yet express our agreement with the author's reiterated statement, that practice and observation are more educative than a textbook Without wishing to be unduly critical, we may, however, remark, that it is irritating to be told frequently that it is "needless to say" so-and-so, when obviously so-and-so follows we must offer cordial approval of the illuminating notes upon the use of colour

The personal friends and colleagues of the late Prof Adrian Stokes have decided to establish some form of permanent memorial in recognition of the man and his work. They feel that the endowment of medical research, through the establishment of a Stokes Research Fellowship or Studentship, which is at present under consideration by the Medical School of Guy's Hospital, is the only form of memorial that would have met with his own approval, and they are anxious that the memorial should be worthy of one who lived and died for the manifestation of scientific truth. The Dean of the Medical School, Guy's Hospital, London, S.E. 1, will gratefully acknowledge any contributions to the fund.

With the opening of the 1927–28 session, the Institute of Metals takes possession of its new head-quarters, which include an additional library and reading room, at 36 Victoria Street, London. S.W 1.

THE thirty-ninth Congress and Health Exhibition of the Royal Samtary Institute will be held at Plymouth on July 16-21, 1928, under the presidency of the Right Hon. The Viscount Astor.

In recognition of his valuable services to public health, Sir Ronald Ross, director-in-chief of the Ross Institute and Hospital for Tropical Diseases, has been awarded the Harben Gold Medal for the year 1928 of the Royal Institute of Public Health.

The Kaiser-Wilhelm Institute for Anthropology was inaugurated in Berlin-Dahlem on Sept. 15 by Herr von Harnack, the president of the Kaiser-

Wilhelm Gesellschaft Prof Eugen Fisher, the director of the new Institute, outlined the programme. In addition to the anthropological department, there are others devoted to heredity and eugenics

SIR WILLIAM BRAGG will deliver a lecture on "Crystallisation" at the opening meeting of the 1927–28 session of the Institution of Chemical Engineers. The meeting will be held in the Institution of Civil Engineers, Westiminster, on Friday, Oct 28, at 6 30 PM. There will be no charge for admission, but tickets (to admit two) can be obtained on application to the honorary secretary. Institution of Chemical Engineers, Abbey House. Westiminster

The Chemiker-Zeitung for Sept 14 contains a special 30-page supplement dealing with recent advances in three important branches of chemistry. These reports, which are very highly condensed, and contain copious references to original memoirs, will be found to contain valuable summaries of progress in the following subjects: the investigation of elements and their structure during the period 1923–26, by Prof. W. Herz: the petroleum industry in 1926, by Dr. R. Kissling, and industrial inorganic chemistry from 1924–26, by Dr. Bruno Waeser.

In order to provide for the more speedy publication of contributions to the Faraday Society, the Council has decided that future volumes of the Transactions shall be published in twelve monthly parts of about 48 pages each. The first part will appear on Jan 1, 1928, and will be followed by the others normally on the first of each month. In the case of those General Discussions the report of which extends over more than one part, two (or more) parts may for convenience be published simultaneously within one cover. The subscription to membership of the Society (including the receipt of the Transactions) will remain as before. The Transactions will still be available to non-members in the volume form or in parts as issued.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :-- A principal of the Aston Technical College-The Chief Education officer, Education Office, Margaret Street, Birmingham (Oct. 17). A head of the chemistry department of the Rutherford Technical College, Newcastle-upon-Tyne—The Director of Education, North imberland Road, Newcastle-upon-Tyne (Oct. 29). An assistant lecturer in water supply and sewerage in the University of Western Australia —The Agent-General for Western Australia, 115 Strand, W.C.2 (Nov. 1). A professor of organic chemistry, pure and applied, in the University of Sydney, New South Wales—The Agent-General for New South Wales, Australia House, Strand. W.C 2 (Nov. 9). A research officer at the Vetermary Laboratory of the Ministry of Agriculture and Fisheries at New Haw, Weybridge—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Nov. 30). A superintendent of weights and measures under the Sudan Government-The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, S.W.1.

#### Research Items.

PALEOLITHIC SITE AT ROCHETTES, DORDOGNE --In 1925, Mm Courtier and Emetaz gave an account at the Archæological Congress at Grenôble of the excavation of a rock-shelter at Rochettes, immediately to the south of that explored by Hauser, which revealed a series of stratifications extending from the Lower Mousterian to the Upper Aurignacian, entirely undisturbed. In the Bulletin de la Société d'Anthropologie de Paris, 7<sup>me</sup> série, t. 7. fasc. 4-5-6, the authors describe further investigations on the site which have produced evidence of importance on three points. First, on the transition from Mousterian to Aurignacian. The lowest stratum (No 6), of dark yellow sandy soil, contained implements including racloirs of La Quina type belonging to Early Mousterian. Above this was a stratum, also of a sandy soil, lighter in colour, with coups de poing, oblong racloirs, and bones of developed Mousterian type. Above, in the fourth stratum, characterised by hearths with carbonised bone, was an industry much less highly developed than that of the stratum below, with numerous flakes, which in character are comparable to the industry of the Early Aurignacian rock-shelter at Audi. That is, the fully developed Mousterian is here followed immediately by an undeveloped industry of an entirely different technique, which is to be regarded as Aurignacian The site, therefore, gives indubitable evidence of the sequence of one industry to the other. The second point upon which the excavation furnished evidence is the occurrence of red ochre on a Mousterian site; a piece of this material showing two grooves made by a flint implement was found in the lowest stratum, which is taken to indicate that this material, used by the Aurignacians as pigment, was also employed by the Mousterians, though for what purpose is not known In the fifth or upper Mousterian stratum was found a bear's tooth, grooved for suspension as an amulet. This also is unique in Mousterian culture, and must be added to the small number of objects of amuletic purpose belonging to this culture already known.

ANTS AND APHIDS.—Observations on the relations ('trophobiosis') between ants and aphids have been made by H. Eidmann near Munich (Biol. Zentralbl., Band 47, p. 537-556, 1927). Certain aphids overwinter in the nests of *Lasius niger*, and these ants appear to exercise a sort of control upon the time of the going out of the aphids from the nest on to the trees. The aphids are watched and guarded by special watcher ants-workers-which remain, as marking experiments have shown, the whole day near their protégés and return each day again to the same place So long as the nights remain cold the aphids are brought back again into the nests of the ants. In summer when the aphid colony is very large and the nights are warm, the search by the ants for the aphids takes place after nightfall. The ants avoid daylight as much as possible, but nevertheless a watcher remains behind the whole day, even in bright sunlight, near each herd of aphids. The amount of food brought into a large colony of Lasius niger by its workers in their crops may amount to a litre of aphid honey during the summer.

Growth of Salmon.—In a paper entitled "Some Aspects of the Growth of Salmon in River and Sea as observed from Scale Examination of Dee (Aberdeen) and Spey Salmon 1921 to 1923 inclusive" (Fisheries, Scolland, Salmon Fish. 1927, I. (March 1927)), Mr W. J. M. Menzies summarises such conclusions as are warrantable on condition, calculated lengths and

times of rapid and slow growth Examination of condition, as represented by the relationship of weight to cube of length, shows that summer fish are fatter than spring fish, and that condition improves with age and length. A study of the calculated lengths reveals the fact that it is a general rule that the subsequent growth and behaviour of the pair and smolt are determined by the first year's growth A poor first year parr makes poor growth throughout the river life; a good first year parr increases its advantage in the second year, and probably then migrates to the sea as Spey parr and smolts are slightly longer than Dee parr and smolts This dependence upon the first year's growth appears to be maintained also throughout the marine life The slow growth period extends to April, during which month rapid growth begins and reaches a maximum in August. A check during rapid growth occurs in many fish in June and July. With the accumulation of further material, the Scottish Fishery Board will be in a position to review the final distribution of the complete hatch of a single season in either Dee or Spey.

THE SIZE OF WHALES—The literature of whales and whaling has been much added to of late, and five of these recent works are made the subject of an interesting article by Mr. J. J. Bell in the July issue of *The Quarterly Review* While the greater part of the article is devoted to a review of "Pursuing the Whale " (Murray, 1926), a circumstantial account by Capt. John A. Cook of his whaling adventures, the chief scientific interest attaches to an incident m Mr. Bell's own experience. It has been very generally assumed that the Blue Whale (Balænoptera musculus (L.) = B. sibbaldii (Gray)) attams to much greater dimensions in the Antarctic than in the Arctic Ocean, and some naturalists tend to distinguish the southern form as a distinct race. Trustworthy data regarding the upper limit of this species in northern waters are therefore of value. Mr. Boll states that in northern Iceland he measured a specimen between perpendiculars and found it to have a total length of 86 feet. This measurement would place his example among the largest recorded from the Arctic On the other hand, he also mentions receiving "the trustworthy account of a Blue Whale killed in the Antarctic, which measured 110 feet," a record which, if really trustworthy, would tend to support the view that a greater size is there attained by this species. Perhaps, however, the true solution is that suggested by Sir Sidney Harmer (*Proc. Zool.*) Soc., p. 1089, 1923), namely, that Blue Whales of the largest size have become practically extinct in the north on account of the long-continued intense whaling in those waters.

BEACH VEGETATION IN THE PHILIPPINES—The classical work of Schimper on the beach vegetation of the Indo-Malayan region will always form the basis for any work of that kind done in this region—Schimper, however, does not discuss the ecological anatomy of the sandy beach species—Recent work by Raymond Kienholz (Proceedings of the American Philosophical Society, vol. 55, No. 5 (Supplement), 1926) is thus of interest because, apart from the distribution of the various species, the author has made a detailed study of the anatomy of a number of species in relation to the particular conditions of this beach environment. The beach is divided into three physiographic areas, each with its characteristic flora: (1) Sandy beach; (2) rocky headland, and (3) muddy flats, of which only the first two are considered in the present paper.

The sandy beach is characterised by creeping herbaceous forms, such as Spinifer littoreus, and Ipomaa pes-capiæ, with a shrub-tree zone on the upper beach composed chiefly of Scavola frutescens, Tournefortui argentea, Pandanus spp. and various trees The flora of the rocky headland is derived partly from the sandy beach, partly from the interior forests. In both habitats evaporation is high, wind movement strong and steady. Intense sunlight, salt spray, and rapid drying out of the sand, together with the factors first mentioned, produce a severe environment, particularly as regards the water relations of the plants. The author considers that these severe environmental conditions have affected the habit and especially the leaf structures of the species Leaves of the twentytwo species examined exhibit many xerophytic structures—leaves more than 350 microns in thickness large quantities of water storage tissue, sunken Very detailed measurestomata, and thick cuticle ments are given of the various structures, which are illustrated by seven plates.

STORAGE AND TRANSPORTATION DISEASES OF VEGETABLES —In No 81 of the Technical Bulletin of the Agriculture Experiment Station, Michigan State College, Ray Nelson records some work he has carried on along lines similar to those followed by Franklin Kidd, Cyril West, and M. N. Kidd for the Department of Scientific and Industrial Research (see Nature, vol. 119, June 4, p. 830). These latter investigators found that by controlling the storage atmosphere of living fruit through a reduction in the percentage of oxygen and an increase in the carbon dioxide, the storage life of the fruit could be lengthened present author now traces certain non-parasitic diseases, including black lear speck of Cruciters, red meast of lettuce and cabbage, and surface pitting of potato tubers, to madequate supplies of oxygen in the storage chambers, or to temperatures which prevent the utilisation of the oxygen present. He has been able to reproduce some of those diseases under controlled laboratory conditions, and comes to the conclusion that both the factors of air composition and temperature are important in causation. In some of his experiments the amount of oxygen in the atmosphere fell as low as 25 and 1.0 per cent He suggests that the ultimate cause of those diseases is the liberation or accumulation in certain cells of some toxic substance resulting from the interaction of a hydrolytic enzyme and a glucoside, due to a deficiency of oxygen, one of the results of this interaction being an oxidation process causing the pigmentation characteristic of many of those break-down diseases. As a control measure proper aeration of storage chambers is recommended. On the other hand, the Cambridge investigators found that a regulated atmosphere containing a constant 10 per cent. of oxygen and a corresponding increase in carbon dioxide gave the best results As the research stands at present, there seems to be an optimum concentration of oxygen which slows up respiration sufficiently to give increased longevity to storage fruit and vegetables, but, if decreased, it may give rise to the various pathological symptoms incidental on suboxidation which the author describes.

The Rainfall of Australia.—The rain map of Australia for 1926, published by the Commonwealth Government, contains, as usual, maps showing the monthly tall and departures from the normal. It is based on the records of some 1300 stations. During the year, as in the previous four years, less than one-quarter of the continent had rainfall above the average. In the south-west of Western Australia the fall was the greatest on record. There were also good rains in

the northern and central areas of New South Wales and in south-eastern Australia. But some parts of the continent experienced serious drought. In Queensland the drought which began in 1925 became more pronounced and had disastrous results, causing great loss of sheep, a failure of cereals, and a much diminished output of sugar. In South Australia the rain was below the average, but on the whole there was no serious shortage. In New South Wales, Victoria and Tasinania the rainfall conditions were generally favourable and local deficiencies were only slight.

PTOLEMY'S TORTOISE MARSHES —Much speculation has ranged round the identity of Ptolemy's Tortoise marshes (Chelonitides paludes), which he placed on his river Gir in lat. 20° long 49°. Various authorities have identified the marshes with Lake Melghii in southern Algeria. Lake Fittii in the Wadai region, or the salt lake of Merga in lat 19° 3′, long 26° 19′. In a paper in the Geographical Journal for September, on the problems of the Libyan desert, Dr. J. Ball discusses these identifications. He visited Lake Merga, and cannot reconcile it with Ptolemy's description of the Tortoise marshes In its place he suggests the Kufra oasis Correcting Ptolemy's positions in terms of his known errors. Dr Ball finds that Kutra is in close agreement with the Tortoise marshes Further, he points out that the Kufra is an extensive tract of low ground with many lakes and salt marshes and has distinctly the form of a valley. This might easily have suggested a series of marshes formed by a river coming tiom the south-west. Ptolemy might have mistakenly interred that the river reached the Mediterranean.

FIRE RESISTANT CONSTRUCTION.—Special Report No 8 of the Building Research Section of the Department of Scientific and Industrial Research (London: H.M. Stationery Office, place 1s. 6d net.), deals with the effect of high temperatures on building materials generally, and describes experiments carried out in the endeavour to elucidate and then to improve the fire-resisting properties of concrete. It is shown that by the addition of a pozzolanic material to Portland cement, a very considerable absorption of the line (set free on hydration of the cement) can be brought about. The presence of the lime is shown to be the most serious factor in the deterioration of cement under fire The work described has been carried out over a period of two years, and the results are, therefore, considered to represent actual conditions fairly well. A report will be issued when the material has been under observation for five years. The report is well illustrated and provided with a bibliography, and it represents a very valuable addition to our knowledge of building materials.

THE GRAVITATIONAL CONSTANT -A preliminary notice of a new determination of this quantity at the U.S. Bureau of Standards has been published by P. R. Heyl in the August number of the *Proceedings* of the National Academy of Sciences. The method employed was one in which a torsion balance is used dynamically. The attracting masses were steel cylinders, each weighing 66 kg., and the oscillating system consisted of two 50 gm. platinum balls on the ends of a light rod of aluminium, which was suspended by a thin tungsten filament wire a metre long; elaborate precautions were taken to ensure that the metal was homogeneous. The time of oscillation was 29 minutes when the gravitating bodies were as near as possible, and rose to 34.5 minutes when they were separated. The five values of G obtained in 1926 differ amongst themselves by less than one part in a thousand, and yield a mean value of  $6.664 \times 10^{-8}$ .

# The International Congress of Physics.

DURING the week commencing on Sept 11, a meeting of exceptional interest was held at Como in Italy, in commemoration of the first centenary of the death of Volta. It is probable that no previous congress has ever brought together so representative a gathering of physicists, for, with very few exceptions, the leading authorities in all branches of the subject attended the meeting and gave short addresses on developments in their own fields Fourteen countries were represented by about sixty guests who were invited to attend the congress; these included amongst their number eleven Nobel laureates The meeting will surely be remembered as a historical

The programme was divided into five general sections, one for every day.

(1) Researches into the structure of matter.

(2) Electricity and its applications.

(3) Electrical theory

(4) Physical optics

(5) Theories of the structure of matter and of

On the sixth day, in the lecture-room of Volta at the University of Pavia, a résumé of the work which had been accomplished and of the problems discussed was presented by Prof. Lorentz representing the theoretical physicists and by Prof. Majorana re-

presenting the experimental physicists.

The scientific meetings at Como were followed by a visit to Rome. The members of the Congress were received by the Italian Premier, Signor Mussolini, who expressed his appreciation of the work which had been accomplished. Senator Marconi. who delivered an address in the Capitol on Volta's life and work, expressed the feelings of all who attended the conference when he congratulated the president, Prof Majorana, and secretary of the Congress. Prof. Pontremoli, on the way in which the meeting was organised and conducted.

The following brief notes will indicate the trend of

the discussions which took place:

# RESEARCHES INTO THE STRUCTURE OF MATTER.

The meeting was opened with a lecture by Sir Ernest Rutherford, on the structure of radioactive atoms and the origin of a-particles. Sir Ernest proposed a new theory which, introducing neutral particles around the nucleus, gave an explanation of many experimental facts. A general discussion followed, conducted principally by Prof. Lorentz. Prof. J. Franck of Gottingen gave afterwards a very interesting account of "Band Spectra and Chemical Phenomena," in which he put forward a new optical method of determining the energy of dissociation of normal or excited molecules.

Dr. F. W. Aston described his latest results with his improved mass spectrograph and the conception of the structure of nuclei to which they led. In his paper he referred to the theories of Sir Ernest Rutherford described above. Dr. Aston also announced the discovery of some new isotopes. Prof. Gerlach spoke about magnetic susceptibilities of gases; he developed the theory of the experiment of Stern and Gerlach, and announced that experiments made on susceptibilities of gases show conclusively that no quantisation of direction is present in diamagnetic gases. Prof. Cabren described the magnetic properties of the palladium and platinum groups and their significance in the theory of paramagnetism. Prof. Stern described a new method for studying the electrical and magnetic deflexion of molecular rays, and gave some account of experiments on the reflexion of hydrogen molecules at a highly polished plane surface Prot H. D. M. Bose presented some investigations on paramagnetism Prof W. L Biagg gave a highly appreciated account of the diffraction of electromagnetic waves by crystals, and Prof Smekal opened an interesting discussion on the structure of actual crystals. Prof. Langmuir described some very recent observations on the electrical discharge in gases at low pressure, and directed attention to important questions in this field. The Due de Broglie spoke on the absorption by matter of Rontgen radiation, and Prof Compton dealt with the action of radiations upon electrons.

#### ELECTRICITY AND ITS APPLICATIONS.

The discussion was opened with reports by Prof. Kennelly on the normal attenuation in electrical nets, by Prof. K. W. Wagner on electrical filters and reiterative conductors, by Prof. Boucherot on the utilisation of the cold water of the bottom of the ocean. Prof. Janet spoke on the construction of electrical machines, and Prof. Cotton described the great magnet now in construction at the laboratory of Bellevue, France, which is designed to give strong and extended magnetic fields and will require 100 kv. for its excitation. Prof. Tolman described his experiments on electrical effects due to mechanical movements of matter. Prof. Majorana demonstrated with experiments his method of transmitting speech by ultra-violet light, Prof. Wood gave an extremely interesting report on biological and physical effects produced by ultrasonic vibrations obtained with piezoelectric oscillators. The oscillator works at 500,000 periods and very curious effects are observed In oil a very marked pressure of radiation is detected; a glass wire acted on by these vibrations gives high calorific effects, frogs and fishes are killed; the action of these ultrasonic vibrations were illustrated by means of slides, and many questions were put to Prof Wood, whose work opens a very wide field for research. Finally, Prof. Brillouin gave an account of a problem of atmospheric electricity, and Prof. Alcobé presented a historical note on an electrical telegraph preceding the discovery of the cell.

#### ELECTRICAL THEORY.

Prof. Lorentz, who received a great ovation, opened the discussion with a paper on some difficulties connected with the problem of rotating electrons. Prof. Planck discussed the difference of potential in diluted solutions. Prof Corbino the theory of the voltaic cell recently proposed by him, and Prof. Hall the Volta-effect. Afterwards, Dr. Frenkel gave some very interesting views on the electronic theory of metals, and Prof Gruneisen discussed the more recent experiments on thermal and electrical conductivities of metals. The theory of the Voltaeffect and triboelectricity was also discussed in the report of Prof. Perucca Prof. Ehrenhaft spoke on the physics of submicroscope matter, Prof. Lasareff on an electrical theory of vision, Prof. Amaduzzi on a peculiar example of photoelectricity.

#### PHYSICAL OPTICS.

Prof. Millikan reported on cosmic rays: his communication was followed with deep interest and gave rise to discussion by Sir Ernest Rutherford, Prof. McLennan, and others. Prof. La Rosa reported afterwards on the ballistic theory of light; his observations were criticised in a following lecture by Prof. Giorgi, who proposed also some new experiments as crucial tests between the Ritz-, Einstein, and Fresnel-Maxwell-Lorentz theories

Prof. McLennan spoke on the spectrum of the aurora and our knowledge of the high atmosphere. Prof Richardson gave an account of his work on the molecular hydrogen spectrum. Prof Paschen dealt with some new methods of spectroscopic work. Prof. Duane with the character of the general X-radiation, Prof. Saha with the explanation of complex spectra as interpreted by undulatory mechanics Prof. Zeenan gave afterwards a very bulliant and complete report on the emission of radiation in a magnetic field, and illustrated his account with many very interesting slides Prof. Americ closed the meeting with a report on solar radiation.

THE STRUCTURE OF MATTER AND RADIATION.

Prof. Sommerfeld dealt with the theory of metallic conduction and the Volta-effect interpreted by Fermi's statistics, Prof. Levi-Cività proposed a new theorem on adiabatic invariants, Prof. Debye gave an account of the recent work done by himself and his school on dielectrics and the dipole theory, Prof. v. Laue spoke

on the influence of temperature on X-rays interference, Prof Eddington on electrical conditions in stars, Profs Straneo and Gianfranceschi on quantum theory

Prof. Bohr gave a very clear and detailed report on the actual state of quantum theories—he illustrated the points of agreement and of discordance between the different theories and between theory and experiment, and closed his important speech with some philosophical observations on the atomic world. A general discussion followed, conducted by Profs—Born, Krainers, Heisenberg, Fermi, and Pauli, in which the actual situation of this branch of science was reviewed.

The Congress left a very deep impression on all who were privileged to be present, since it provided so complete a review of the more recent developments in all branches of physical science. The discussions were presided over by Prof Majorana (president), and by Sir Ernest Rutherford. Profs. Lorentz. Millikan, and Cotton (vice-presidents). At the conclusion, a resolution was passed proposing that the committee which organised this Congress should be made permanent and endeavour to arrange similar meetings in future years.

# Annual Visitation of the Rothamsted Experimental Station.

AT the invitation of Lord Clinton, chairman of the Lawes Agricultural Trust, a number of visitors inspected the Rothamsted station and laboratories at Harpenden on Sept 29.

Lord Clinton, in welcoming the visitors, briefly outlined the purpose of the station, and its special opportunities in the present world-wide agricultural depression. The remedy of reduced production, he said, is a cry of despair, and the sounder way of meeting the situation is to intensify the level of production.

at a relatively reduced cost.

Sir John Russell, director, reviewed in detail the recent activities of the station. The new glass houses erected with the help of a generous donation from the International Education Board, Rockefeller Foundation, are in use for the study of plant diseases and the preliminary tests of new fertilisers and accessory materials. The periodical conferences held at the station are proving very successful; they are of two kinds: (a) practical, when some specific agricultural problem is discussed by farmers and the station staff, and (b) expert or technical, in which overseas and foreign workers participate, when the position of some fundamental inquiry, as for example soil reaction, is discussed. These conferences not only serve to disseminate widely the latest developments, but are also of great help to the station in drawing up a well-balanced programme of work.

The subject of crop production and improvement naturally bulks largely in the programme of the station. The improved method of seed inoculation for lucerne is enabling the crop to be grown outside the hitherto restricted south-east area of England, and the demand from farmers for cultures is still increasing Progress has also been made in the study and control of the elusive factor of quality in certain crops. Prominent among these are sugar-beet, potatoes, and malting barley, in which respectively the sugar content, the behaviour on cooking, and the character of the malt are as important as the actual yield. At least three-fourths of the malting barley used is home grown, but owing to the influence of introgen content on the malting quality, farmers are loth to use nitrogenous manures to increase the yield.

Co-operative experiments with the Institute of Brewing have shown, in general, that moderate top dressing of nitrogenous tertilisers can be safely used, and the problem is now being pushed a stage further, by biochemical studies of the grain.

Thanks to mathematical study of the statistical requirements of field plot experiments, it has been possible to use greatly improved systems of replicating and randomising the plots, with a concomitant increase in accuracy of the data of yield. At the same time, by keeping the plots under close examination during the growing season valuable physiological and ecological information is being secured, both on the relation of soil and climatic factors to plant growth, and on the connexion between the life-history of the plant and its final yield.

In the field, the comparative effects of alternative systems of cultivation are being directly investigated on a variety of crops. Extended use is being made of the new dynamometer in studying the production by implements of a good soil tilth, and the field observations are being closely followed by laboratory studies of the physical and physico-chemical soil

properties concerned.

Progress has been made in producing synthetic farmyard manure, and the process, developed originally in the Rothamsted laboratories, is now in use all over the world. It has been found of great value in the Empire, particularly in regions where surplus straw, etc, has hitherto been wastefully burnt. In connexion with the purification of the effluent from sugar-beet factories, the earlier Rothamsted work on sewage purification in a filter bed is proving useful.

The new glass houses have enabled the station to add the study of tropical and subtropical plant diseases to its activities. The general endeavour in this work is to aim at preventive rather than curative measures. Nevertheless, the necessity for trustworthy insecticides and fungicides to deal with heavy intestations of disease or pests will remain almost indefinitely, and therefore quantitative investigations on the relation of chemical composition to toxicity, especially of insecticides, are being continued.

# Forthcoming Books of Science.

#### Agriculture, Forestry, and Horticulture.

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Chapman and Hall, Ltd—History of Science Teaching in England, Dorothy M Turner; Bells: Their History, Uses, and Lore, J. R Nichols; Horology: The Science of Time Measurement and the Construction of Clocks, Watches, and Chronometers, J. E. Haswell, Aerial Photography, C. Winchester and F. L Wills. Chatto and Windus—Possible Worlds, J. B S. Haldane A A. Knopf.—Life and the Student Roadside Notes on Human Nature, Society, and Letters, Prof. C H. Cooley. Classics of Modern Science, Prof. W S. Knickerbocker. Longmans and Co., Ltd.—The Beginnings of Organised Air Power, J. M. Spaight. Macmillan and Co., Ltd.—A Study in Public Finance, Prof. A C. Pigou. Adventure The Faith of Science and the Science of Faith, Dr. A. S. Russell, and others, edited by Canon B. H. Streeter. Is there God? or Theistic Monism an Answer reached by determining the Relation of Mind to Body, J. Evans. Methuen and Co., Ltd.—Science of To-day, Prof. J. A. Thomson Charles Scribner's Sons—The New Reformation, Prof. M. Pupin; Creative Education in School, College, University, and Museum, Prof. H. F. Osborn. University of London Press, Ltd.—University College, London, 1826—1926, H. H. Bellot.

#### Philosophy and Psychology.

George Allen and Unwin, Ltd.—The Correspondence of Spinoza, edited, with Introduction and Commentary, by Prof A. Wolf; Philosophy, B. Russell. D. Appleton and Co.—The Psychology of Personality, P. F. Valentine. Ernest Benn, Ltd.—Psycho-analysis, Dr. E. Jones. Cambridge University Press.—Psychology and the Soldier, F. C. Bartlett; The Nature of Existence, the late Dr. J. McT. E. McTaggart, Vol. II. Constable and Co. Ltd.—The Realm of Essence, G. Santayana. J. B. Lippincott Company.—That Mind of Yours: a Psychological Study, Dr. D. B. Leary. Macmillan and Co., Ltd.—Buddhism and its Place in the Mental Life of Mankind, Dr. P. Dahlke, Asoka. Prof. R. Mookerji. John Murray.—Life in the Stars, Sir Francis Younghusband, The Religion of Tibet. a Study of Lamaism, J. E. Ellam (Wisdom of the East Series). Oxford University Press. — Criminal Intelligence, C. Murchison; The Works of Aristotle, translated into English under the editorship of W. D. Ross; Topica and de Sophisticis Eterchis, by W. A. Pickard-Cambridge; Ethical Studies, the late F. H. Bradley; Practical Application of Sociology, H. N. Shenton; The Scientific Habit of Thought, F. Barry; Speaking with Tongues Historically and Psychologically Considered, G. B. Cutten. Kegan Paul and Co., Ltd.—Religious Conversion: a Biopsychological Study, Prof. de Sanctis, The Growth of Understanding, C. A. Claremont. University of London Press, Ltd.—The Next Step in National Education; Universities in the United States, Dr. E. Deller; The Subnornal School-Child, Dr. C. Burt, Vol. II. The Backward and Defective Child; Vol. III. The Unstable and Neurotic Child.

#### Technology.

Ernest Benn, Ltd.—An Encyclopædia of Textiles, Prof. Fleming; An Encyclopædia of Ironwork. Chapman and Hall, Ltd.—The Manufacture of Artificial Silk, with special reference to the Viscose Process, E. Wheeler. C. Griffin and Co., Ltd.—The Bleaching and Finishing of Cotton, S. R. Trotman and E. L. Thorpe, new edition. Crosby Lockwood and Son.—Modern Furniture Veneering, E. W. Hobbs; Preparation of Precious and other Metal Work for Enamelling, H. de Koningh; Gasfitting and Appliances, F. W. Briggs and J. H. Henwood, new edition. Macmillan and Co., Ltd.—Elements of Quality in Cotton, Dr. W. L. Balls. Oxford University Press.—Elementary Building Science, A. Everett; Principles of Mechanism, F. Dyson. Sir Isaac Pilman and Sons, Ltd.—Introduction to Textiles, A. E. Lewis.

# University and Educational Intelligence.

The Sir John Cass Technical Institute of Aldgate, London, offers in its prospectus for 1927–28 a wide range of choice of subjects. Among the more specialised courses are those in gas manufacture and analysis, brewing and malting, and petroleum technology. There is an important department of metallurgy in which students are prepared for the University of London degree of B.Sc. (Engineering) in metallurgy. There are also a department of arts and crafts (including silversmithing, jewelry, and engraving), trade classes, and a nautical school. The new session will be opened on Oct. 10, when Sir William Beveridge will give an address.

THE International Institute of Intellectual Co-operation issues quarterly a Bulletin of Scientific Relations. The issue of August last contains notices of recent and forthcoming international congresses, newly constituted scientific organisations, activities of the scientific relations branch of the Institute, and several special articles and reviews. A description is given of the new "Fondation Edmond de Rothschild," the object of which is to establish at Paris an institute of biology for the investigation of the physicochemical basis of life For this purpose a sum of thirty million francs has been placed at the disposal of a council of twenty-four, comprising delegates nominated by learned societies and members co-opted by the already existent Rothschild foundation for physics and chemistry. The founder holds that of late years the study of micro-organisms has tended to distract the attention of biologists from pursuing the lines of research in physico-chemical reactions associated with the name of Claude Bernard. The new institute will afford facilities for the resumption of research on those lines.

The place of university extension work in State universities in the United States is thus defined in the 1927 "Catalogue" of the University of Colorado . the University's first duty is to teach the students upon its campus, the second to foster and develop the spirit of research on the part of the members of its faculties, the third to render to the State at large such public service as may lie within its power. This third function is exercised through the extension division which is the official representative of the university to its constituents, the whole citizenship of the State. The work of the Colorado University extension division is organised in two departments, those of instruction and of public service. The former has bureaux of correspondence instruction, of class instruction and of visual instruction (chiefly for schools and churches), home-reading courses, and lecture courses. The 'class instruction' is for teachers, club members, business men, industrial workers, and any other group having a common It is comparable with the university tutorial classes of England. The department of public service has bureaux of business and government research, community organisation, library extension, and research and extension in journalism, and it conducts high school visitations and helps to operate a high school debating league. The business research activities include the making of industrial surveys and retail cost surveys, and the conduct of research on various problems connected with public utilities. Community organisation' stands for services in connexion with such matters as public health, child welfare, recreation, and juvenile delinquency. The University Library serves as a reference library for the people of the entire State The journalism bureau is operated jointly by the Extension Division and the celitorial association of the newspapers of Colorado and serves as a common clearing house of information for them.

# Calendar of Discovery and Invention.

October o. 1837.—Under this date. Caroline Fox records a conversation with Davies Gilbert, who gave us interesting accounts of his interviews with George IV. William IV. and the Queen; the two former he visited in right of his Royal Society's Presidentship to get their signatures. To George IV. he went and requested that he would confirm the patent as his royal predecessors had done, and pointed out to him several of their signatures. Would you show me Evelyn's, said the King—I have lately been reading his memoirs with great interest.' Davies Gilbert found and showed it, when the King remarked. 'He was the founder of the Royal Society' Gilbert said it was His Majesty Charles II who gave the first charter. Very true, replied the King, but that was only ex officio, any man who had happened to be in his situation would have done that; but Evelyn was the real founder, you may depend upon it

October 9, 1856—A few days before the first Atlantic Telegraph Company was registered, Bright and Whitehouse, at the offices of the Magnetic Company in Old Broad Street, London, on Oct 9, 1856, showed Morse that signals could be sent at the rate of 272 per minute through 2000 miles of the Company's wire between London and Manchester.

October 10, 1846 -Within seventeen days of the discovery of Neptune by Galle, the Liverpool brewer Lassell, on Oct 10, 1846, with the aid of a fine twofoot reflector, discovered its single satellite. The study of this satellite has enabled the mass of Neptune to be calculated with great exactness

October 11, 1867.—The modern typewriter had its birth in Milwaukee It was the result of the joint labours of Sholes, a collector of customs, editor and printer, Soule, a farmer and printer, and Glidden, a farmer and inventor. Their machine was patented on Oct. 11, 1867, and after many improvements its manufacture was taken up by the Remington firm of gun-makers.

October 12, 1788. - One of the earliest recorded steamboat trials was made in America on Oct. 12, 1788, when one of Fitch's boats fitted with an engine having a cylinder 12 in. in diameter carried thirty passengers from Philadelphia to Burlington, a distance of about 20 miles, in 3 hours 10 minutes. Ten of the passengers afterwards signed a certificate declaring "We, whose names are hereunto subscribed, do certify that we have been in John Fitch's steamboat of 60 ft. in length in the river Delaware, when the said boat was propelled through the water with a considerable degree of velocity regularly and without any manual labour, by the force of steam, and we are clearly of opinion that the rivers of America may be navigated by the means of steamboats, and that the present boat would be very useful on the western waters.'

October 13, 1877.—The first experiment in street lighting by electricity in France was made on Oct. 13, 1877, when the Place de l'Opera in Paris was lighted by a series of Jablochkoff candles.' Jablochkoff was a Russian electrician who died in poverty in 1894.

October 14, 1788 -Patrick Miller's steamboat experiments in Scotland were contemporary with those of Rumsey and Fitch in America; and it was on Oct. 14, 1788, that a trial was made, on Dalswinton Loch, with one of Miller's double-hulled boats fitted with a steam engine by Symington. The enterprise being abandoned, the engine was removed to Miller's library and sixty-five years later was saved from the scrap heap by Bennet Woodcroft. It is now in the Science Museun, South Kensington. E. C. S.

# Official Publications Received.

The Medical and Scientific Archives of the Adelaide Hospital No 6 (for the Year 1926) Pp. 62 (Adelaide)
Cevlon Administration Reports for 1926 Part 4 Education, Science and Art (E) Administration Report of the Director of the Colombo Museum for 1926 Pp. E9+5 plates (Colombo Government Record Office) 55 cents
Federated Malay States Annual Report on the Department of Agriculture, S.S. and F.M.S., for the Year 1926, By A.S. Haynes Pp. 11+17 (Kuala Lumpur Government Press)
The Institute of Chemistry of Great Britain and Ireland Fire Risks in Industry By Alec M. Cameron Pp. 21 (London)
Memoris of the National Museum Melbourne No. 7. Pp. 158+14
plutes (Melbourne H.J. Green.)
Catalogue of Indian Insects By R. Seinor-White Part 12 Tabandiae Pp. 70 (Calcutta Government of India Central Publication Branch.) 1 12 rupees 33
Second and Final Report of the Royal Commission on Mining Subsidence (Cmd. 2891) Pp. 68 (London H.M. Stationery Office) 18 3d net

18 3d net
Aeronantical Research Committee Reports and Memoranda No
1011 (Ae 270) Wind Tunnel Tests with High Tip Speed Airscrews
The Characteristics of a Bi-Convex Aeroloid at High Speeds By Dr.
G P Donalas and W. G A Perring (A3d Airscrews, on -T 2404)
Pp 214-9 plates 1s net No 1005 (Ae 274) Theoretical Relationships for an Aeroloid with Hinged Flap By H Glaiert (A3b
Aeroloids with Flaps of Warped, 29-T. 2458) Pp 13+12 plates 2d
net (London H M Stabonery Office)
Canada Department of Mines Mines Branch Abrasives Products
of Canada, Technology and Application Part I Siliceous Abrasives
Sandstones Quartz, Tripols, Primice and Voicanic Dast By V L
Eardley-Wilmot (No 673) Pp xi+119 (Ottawa F, A Acland)
30 cents

Report for 1926 on the Lancashire Sea-Fisheries Laboratory at the

Report for 1926 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Sea Fish Hatchery at Piel Edited by Prof James Johnstone Pp 107-10 plates (Liverpool) List of the Others and Fellows of the Chemical Society Corrected to July 31st, 1927 Pp 199 (London) Quatterly Journal of the Royal Meteorological Society Vol. 53, No. 223, July Pp 201-325 (London Edward Stantord, Ltd.) 7s. 601 Memoirs of the Department of Agriculture in India Botanical Series, Vol. 14, No. 5 The Indigenous Cotton Types of Burma By T. D. Stock Pp 177-187-5 plates 9 annas, 1601. Botanical Series, Vol. 14, No. 6 A Study of Fusaria Common to Cotton Plants and Cotton South in the Central Provinces By Jiwan Singh Pp 189-198+3 plates 5 annas, 601 (Calcutta Government of India Central Publication Branch.)

Bothalia a Record of Contributions from the National Herbarium, Union of South Africa, Pretoria. Edited by Dr. I. B. Pole Evans. Vol. 2, Part 1b, 31st March. Pp 227-369. (Pretoria) 7s. 601

Empire Marketing Board.

Agricultural Research Council Paper No. 70 Reports on the Work of the Agricultural Research Institutes, 1925-1926. Pp. 11+106 (London Agricultural Research Council.)

#### FOREIGN.

Publikation dei Steinwarte in Kiel 16 · Über die Helligkeitsabnahme von Bedeckungsverandeilichen Von Paul Harzei Pp 34. (Kiel)
Bulletin of the American Museum of Natural History Vol 54, Art 1
The Orthoptera of the West Indies No. 1 Blattide By James A. (Rehn and Morgan Hebard. Pp .120+155 plates Vol. 54, Art 2 The Fishes of Haman By John T Nichols and Chifford H. Pope Pp 321-304+1 plate (New York City)
Proceedinus of the United States National Museum. Vol 71, Art 19
The American Moths of the Genus Diatrica and Allies By Harrison G Byar and Carl Hemitch (No 2264) Pp. 48+20 plates (Washington, DC Government Printing Office)
La Revue acticole egyptienne. Numero special de l'Exposition Generale Agricole et Industrielle, Mars 1920. (Traduction) Pp vn+123+34 planches. (Le Cane. Minist re de l'Agriculture) J. P.T.
Almanach 7 Spezin Československ/ch Inženýrů v Mlade Boleslavi v Četvnu 1927. Pp 435 (Vydal Mate Boleslavi)
Suomen Geodectisen Laitoksen Julkaisuja. Veroffenthchungen des Finnischen Geodatischen Institutes No 7. Die Beobachtungseigebnisse der Sudninischen Triangulation in den Jahren 1924-1926 Pp. in+164 No 8 Ausgleichung einer Dreieckskette nut lauter Laplaceschen Punkten Von V. R. Olander, Pp. in+49 (Helsinki)
National Research Council of Japan Japanese Journal of Geology and Geography Tian-actions and Abstracts, Vol 4, No. 3-4 (1925) Pp. in+60-103+21 27+in+7+plates 2-5. Transactions and Abstracts, Vol. 5, No. 1-2 (1926-1927). Pp. in+70-112+0 plates (Tokyo)
Department of the Interior. Bureau of Education. Bulletin, 1927, No. 5 Extended Use of School Buildings. By Eleanor T. Glucck Pp. v+80. 10 cents. Bulletin, 1927, No. 12 Record of Current Educational Publications, comprising Publications received by the Bureau of Education during January-March 1927 Pp. 50. 10 cents (Washington, D.C Government Printing Office)
Department of the Interior. U.S. Geological Survey. Water Supply Paper 580 Surface Water Supply of the United States, 1928 Part 8. Western Gulf of Mexico Basins. Pp. vi+298+3 plates. 35 cents Water-Su

Journal of the Faculty of Science, Imperial University of Tokyo. Section 1 Mathematics, Astronomy, Physics, Chemistry Vol 6, Part 6 Uber die Maximaloidnung, einiger Funktionen in der Idealtheorie Von Zyott Suektina (Zweite Mittenunz) Pp. 249-25: 0.80 yen Vol. 1, Part 7 On the Distribution of the V-locities of Stats of the Spectral Type K By Masahi Kaounali Pp. 255-300 0.00 ven Vol. 1, Part 8 Monthly Normals of Iso are in Japan at the Height of 3000 metres, by Ukitiro Nakaya. The Monthly Normal Isobars at 4000 and 6000 metre Levels over Japan and its Vicinity, by Katti Smoda; On the Distribution of the Mixing Ratio of Aqueous Vapour in Atmospheric An near the Earth's Surface, by Toratino Minami and Yosisige Hukumoto Pp. 301-347-420 plates. 1.50 yen Vol 1, Part 0 Uber die Maximalordinang einzier Funktionen in der Ideatheorie. Von Zyott Suetima. (Dritte Mittelling) Pp. 340-371 0.00 yen Section 2: Geology, Mineralcy, Geography, Seismology Vol 1, Part 9 Tertiary Mollusca from Southern Tutomi, by Matajiro Yokoyama; Tertiary Shells from Tosa, by Matajiro Yokoyama, Possil Mollusca from the Arsumi Pennisula, Mikawa, by Matajiro Yokoyama, Possil Mollusca from the Ubjer Husashino of Akita, by Matajiro Yokoyama Pp. 313-380-4 plates 38-45 2.20 yen. Vol. 1, Part 10 Mollusca from the Upper Musashino of Tokyo and its Suburbs, by Matajiro Yokoyama; Mollusca from the Upper Musashino of Western Shimosa and Southern Musashi, by Matajiro Yokoyama Pp. 301-457+plates 40-52 2.00 yen. Vol. 2, Part 2: Physiographical Studies of the Great Earthquake of the Kwanto District, 1923 By Prof Naomasa Yamasaki Pp. 77-119+plates 40-62 2.00 yen. Vol. 2, Part 1. Experimentelle Zytologische Bettrage von Ghei Yamala. Pp. 124-13 plates 4.00 yen. Section 4 Zoology Vol. 1, Part 2 Report on Japanese Pyanduridos. By Prof J Arthur Thomson and Nita I Rennet. Pp. 115-143+plates 10-11 2 60 yen. (Tokyo. Matuzen Co., Ltd.; Berlin. R. Friedlander und Sohn.)

#### CATALOGUES.

The Taylor-Hobson Outlook. Vol. 3, No. 6, September. Pp. 49-60 (Leicester. Taylor, Taylor and Holson, Ltd.)
An abridged Price List of Artificial Stullight Apparatus. Pp. 10 (London: Watson and Sons (Electro-Medical), Ltd.)
The Mutochrone. for the Production of Colour Designs Pp. 1v+16. (London: Adam Hilger, Ltd.)
Illustrated Books, 15th Century to Present Day. (Catalogue 500) Pp. 73 (London: Francis Edwards, Ltd.)
Eastman Organic Chemicals. List No. 17, September. Pp. 79. (Rochester, N.Y. Eastman Kodak Co.)

# Diary of Societies.

FRIDAY, OCTOBER 7.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—Discussion on The Meeting of the International Union of Geodesy and Geophysics at Prague, 1927, September 3-10. Chairman Sir Gerald Lenox Conyngham. Speakers Sir Henry Lyons, Prof. Turner, Prof Chapman, Prof. Proudman, Dr. Crichton Mitchell, Mr. Lempfert, Mr. Mattheway 2014 Chem. Matthews, and others.

#### SATURDAY, OCTOBER 8.

SAIGNDAY, OCTOBER 6.

BIOCHEMICAL SOCIETY (IN BIOChemical Laboratory, Cambridge), at 3.—
Dr. S B Schryser and K. V. Thimann The Scission of Gelatin into Constituent Proteins.—G. S. Haynes and C. G. L. Wolf The Interferometer Method for the Diagnosis of Pregnancy and Malignant Growths.—I. Smedley MacLean. The Isolation of a Second Sterol from Yeast Fat.—T S. Hele. On the Origin of Ethereal Sulphates —J. R. Marrack and L. F. Hewitt The Osmotic Plessure of Iso electric Egg Albumm —L. F. Hewitt: Adsorption of Phthalein Dyes by Proteins.—M. Stephenson. On a Cell-free Dehydrogenase Obtained from Bacteria.

Bacteria.

Hull Association of Engineers (at Technical College, Hull), at 7 15.

J. Shepherd: Three Years' Engineering in Mesopotamia

#### MONDAY, OCTOBER 10.

ROYAL SOCIETY OF MEDICINE (War Section), at 5 —Surg. Vice-Admiral A. Gaskell: Professional Opportunities of the Service Medical Officer (Presidential Address)

BRITISE PRYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6 — Miss E. G. Hume: Disability in Reading. Institution of Automobile Engineers (Bristol Centre) (at Merchant Venturers' Technical College), at 6 45.—Major R. G. Beaumont: The Influence of the Automobile User upon the Automobile Engineer (Presidential Address). (Presidential Address).

(Presidential Address).

INSTITUTE OF METALS (Scottish Local Section) (at Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow), at 730—S. E. Flack: Chairman's Address.

INSTITUTE OF BREWING (London Section) (at Engineers' Club, Coventry Street, W 1).—Discussion on Season's (1926) Malts.

MEDICAL SOCIETY OF LONDON.—H. W. Carson: Surgery in the Early Days of the Medical Society of London (Presidential Address)

#### TUESDAY, OCTOBER 11.

ROYAL SOCIETY OF MEDICINE (Therapeutics Section), at 5—Dr. J A Gunn. Pharmacological Syndromes (Presidential Address)
INSTITUTION OF PETBOLEUM TECHNOLOGISTS (at Royal Society of Arts), at 530.

AUGUST OF MARINE ENGINEERS, at 6 80.—A F C. Tinipson: A New Form of Insulating Material for High Temperatures.
INSTITUTION OF HEATING AND VENTILATING EXONEERS (at Caxton Hall, Westminster), at 7.—Dr. J S Owens: Atmospheric Pollution

No. 3023, Vol. 1201

QUERETT MICROSCOPICAL CLUB, at 7 30 -Dr W B Briefley The Micro-flora of the Soil

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Royal Society of Arts), at \$15-Dr J Rickman and Dr H. G Baynes The Standpoints of Freud and Jung

#### WEDNESDAY, OCTOBER 12

Society for the Study of Inderitt (at Medical Society of London), at 4-Prof W E Dixon The Tobacco Habit (Norman Ken Memonal

Lecture)
INSTITUTE OF METALS (Swansea Local Section) (at Thomas' Cafe, High Street, Swansea), at 7—Capt L Taveiner Chairman's Addiess Folk-Lore Society (at Wellcome Historical Medical Museum), at 8 OIL AND COLOUR CREMISIS' ASSOCIATION (at Royal Society of Arts), at 8—Dr C Beavis, Dr L C Martin, Dr S G Barker, Mrs F E Loubond, J Guild, R S Horsfall, and others Discussion on Colour Standardisation and Testing in the Paint and Colour Industry Institution of the Rubber Industry (London and District Section) (at Engineers' Club, Coventry Street, W 1)—Dr. O. de Vries. Coagulation, Structure, and Plasticity of Crude Rubber.

#### THURSDAY, OCTOBER 13

ROYAL PHOTOGRAPHIC SOCIETY OF GRFAT BRITAIN (Colour Group), at 7.

—J C Warburg The Colour Slides of Lantein Plate Size, included in the Annual Exhibition, to be shown on the Screen
INSTITUTE OF METALS (London Local Section) (at Society of Motor Manufacturers and Tradeis, Ltd., 83 Pall Mall, S.W.1), at 7.30—A. H. Mundey Works' Economics (Chairman's Address)
INSTITUTION OF THE RUBBLE INDUSTRY (Birmingham and District Section) (at Grand Hotel, Birmingham)—A. E. Hemsworth Selling

#### FRIDAY, OCTOBER 14

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 -Sir Aithur Keith Results of Recent Researches into the Reproduction and Growth of

Hone
JUNIOR INSTITUTION OF ENGINEERS, at 7 30.—F A SIMPISON. Problems
created by the Rapid Development of the Motor Car Industry.
INSTITUTE OF METALS (Sheffield Local Section) (in Non-Ferrous Section
of the Applied Science Dept, The University, Sheffield), at 7.30—
J H G. Monypenny Science and Industry (Chairman's Address)
Society of Chemical Industry (Chairman's Address)
Society of Chemical Industry (Chairman's Address)
Society Development of Spray Development of Development of Spray Development of 
Spray Drying

SATURDAY, OCTOBER 15

Physiological Society (at Guy's Hospital), at 3 30

#### PUBLIC LECTURES.

SATURDAY, OCTOBER 8

HORNIMAN MUSEUM (Forest Hill), at 330—Prof. J R Ainsworth Davis: The Romance of the Spice Islands.

#### MONDAY, OCTOBER 10

UNIVERSITY COLLEGE, at 5 -J A Wilks The Library of University College -Prof G Dawes Hicks. A Century of Philosophy at University College -R J Lythgoe Vision (Succeeding Lectures on October 12, 17, 19, 24, and 25)

#### TUESDAY, OCTOBER 11

University College, at 3 - Prof E A. Gardner The Study of Greek Sculpture

#### WEDNESDAY, OCTOBER 12.

KING'S COLLEGE, at 5 30 .- Prof J Dover Wilson: The Nation and its Schools

LONDON SCHOOL OF ECONOMICS, at 6 —L. S. King. Office Machinery. Demonstration of the Teletype.

#### THURSDAY, OCTOBER 13

University College, at 5 15 -Dr. T. G Pinches: New and Noteworthy Assyrian Texts.

# FRIDAY, OCTOBER 14.1

UNIVERSITY COLLEGE, at 5 - Dr Phyllis M Kerridge . Hydrogen Ion Concentration. (Succeeding Lectures on October 21 and 28)

### SATURDAY, OCTOBER 15

Horniman Museum (Forest Hill), at 3 30 -Miss M A Murray Egyptian Temples.

#### CONGRESSES.

OCTOBER 8 TO 11

INTERNATIONAL CONGRESS OF HYDROLOGY, CLIMATOLOGY, AND GEOLOGY (at Lyons).

OCTOBER 11 TO 15.

FRENCH CONGRESS OF MEDICINE (at Paris)

OCTOBER 16 TO 22.

CONGRESS OF INDUSTRIAL CHEMISTRY (at Paris).

OCTOBER 18 TO 23.

JORNADAS MÉDICAS DE MADRID (at Madrid).



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# Imperial Agricultural Research.

T is distinctly unfortunate that the first seven plenary sessions of the Imperial Agricultural Research Conference were held during the week in which two political parties held their annual conferences. The subject matter under discussion at the research conference is of the greatest significance to an Empire in which the foremost industry is agriculture and the future of which depends wholly upon the progressive realisation of the vast potential resources of the lands which it embraces. Nothing has been left undone by the Empire Marketing Board and the Ministry of Agriculture to emphasise these two points reports, memoranda, and pamphlets which they have prepared and distribated to the delegates present for their information and guidance in discussing the various items on the agenda are calculated to interest a wide public, and would undoubtedly have been extensively used by the Press for this purpose had the meetings to which they refer been held a week earlier 
It can scarcely be expected, however, that the Press will give undue prominence to a conference dealing with such impersonal and serious questions as those relating to the influence of scientific research upon our economic position, unless they are dealt with in a brilliantly illuminating and arresting manner and by speakers who have attained a position in popular esteem which rivals that held by the leaders of the Conservative Party and the Labour Party respectively.

The items on the agenda were so arranged that the plenary sessions during the opening week were devoted to the consideration of administrative questions The task of considering the agricultural problems confronting the various parts of the Empire, for the solution of which the aid of science must be invoked, has been delegated to groups of specialists. Now it cannot be suggested seriously that any of the so-called technical questions which have been delegated for the consideration and report of specialist commissions, questions affecting veterinary science, soils and fertilisers, plant pathology, the preservation and transport of food and raw materials, animal and plant genetics, agricultural economics and dairying, are without interest for any of the delegates present at the Conference. Time spent on the discussion of the problems related to these various branches of agricultural research would have been exceedingly well spent The delegates would have been able to grasp the magnitude of the responsibilities of the agricultural services, they would have been able to envisage their problems as a whole and the inter-relations of the work already being carried out in various constituent parts of the Empire, and to survey the possibilities of co-operation in connexion with the researches already in progress and those others which the Conference might decide were imperatively needed.

However, it was pre-ordained that the Conference should give first consideration to administrative questions relating to staffs and institutions. The discussions which arose out of them at the plenary sessions are certainly illuminating. . In connexion with man-power, it was alleged that there is a serious shortage of suitable candidates for most branches of scientific services supported by Governments, a shortage which is being accentuated by the growing demand for specialist officers made by the non-self-governing dependencies. The Research Sub-Committee of the Imperial Conference attributed this shortage to the wholly inadequate appreciation of the importance and value of scientific research on the part of the public, of the Press, and even of Governments themselves: to the uncertainty in the minds of students embarking on a university course as to the career offered by agricultural research: to the increasing demand by private employers for men with a university training in science: and to the lack of knowledge shown by educational institutions and parents of the careers available overseas in the various branches of science and their special attractions. The shortage of candidates is particularly acute in the services—other than medical—for which a training in the biological sciences is a requirement.

The only satisfactory and permanent remedy for this state of affairs, suggested Lord Lovat, Parliamentary Secretary of State for the Dominions, is to make the Agricultural Research Services in pay, status, career, and rewards the equal of other Government services carrying equal duties and responsibilities. It is folly to expect that the best men from the universities will be attracted to agricultural science while there are so few definite and certain prizes at the top. High initial pay is an insufficient inducement. Practically every subsequent speaker endorsed these views, which will obviously commend themselves to every scientific worker in the Empire.

These are the views which have been advanced from time to time in our columns. Generally speaking, the flow of entrants to a career is regulated by its attractiveness, and not the least attractive aspect of a career is its estimation in the public

This esteem must be more than recognition of the money value of those officers who enter specialist services, it should include a proper understanding of their creative outlook. Nothing has done more harm to scientific workers than the popular acceptance of the theory the those who have achieved eminence in a particular field of science have become so specialised in their interests and so biased as to render them unfit for positions of administrative responsibility. Too early specialisation in a student's career would, it is true, tend to produce an undesirable narrowing of outlook, but provided specialisation is left to the post-graduate stage of a student's educational career, there could be no better preliminary training for future administrators than that provided by a liberal and general course in science. This fact has been recognised by certain provincial governments in India. They have been recruiting their Indian administrative staffs from the scientific institutions, particularly the colleges of agriculture in their provinces, and have found this method thoroughly satisfactory.

It is imperative that any general science course in the schools should include general biology as a subject and should not be confined, as it is in most schools in Great Britain, to physical and chemical science. The interest which is stimulated in a subject at school has a direct bearing upon the course of study undertaken at a university. Moreover, as Sir Daniel Hall rightly observed, biology should be taught in the schools not only because the Empire will have to make greater and greater demands for trained investigators in the field of biology, but also because no man can properly be regarded as well-educated who does not fundamentally understand how a plant grows and how an animal lives and has its being. If, moreover, as Sir John Farmer pointed out, an interest in biology were stimulated in the schools, it would not be taken up as a 'soft-option' at the universities mainly by those students who were conscious of their deficiencies in physics and chemistry.

The suggestion that the shortage of biological students at the universities is due to the lack of endowments for biological study was discounted by Major Walter Elliott. He emphasised the fact that there is no shortage of candidates for the medical schools, for the obvious reason that parents are satisfied that medicine provides a satisfactory career for their sons and daughters. To the proposition that scholarships should be provided for public and other secondary schoolboys to enable them to take up agricultural science at the uni-

reprisity under the condition that they afterwards 'entered the agricultural service, he was resolutely opposed. This inducement, like the provision of pensions under the Civil Service scheme for the retention of officers in the service, he regarded as coming within Sir James Currie's definition of "attracting candidates by means of well-baited out otherwise poor booby-traps"

Various other means of stimulating recruitment to the overseas services were discussed. It was pointed out that various post-graduate scholarship schemes in existence have been successful in this regard. Those scholarships provided by the Government, tenable at the Imperial College of Agriculture at Trinidad, have already provided a number of officers for the colonial agricultural services in the Tropics. The scheme of the Empire Cotton Corporation has also been successful in obtaining men for cotton research in various On the other hand, no success has so territories far attended the efforts of the Australian Commonwealth Government to obtain recruits for certain biological services by the grant of sımılar scholar-The Commonwealth offered post-graduate scholarships to the value of £300 a year for two years, with £150 travelling allowance, in addition to the payment of all special fees in connexion . with study. Some of these scholarships were offered to enable students to specialise in mycology and genetics. On the completion of their course, they were to be guaranteed at least three years employment under government at a minimum salary of £400 for the first year, £450 for the second. and £500 for the third. No applications were received for these scholarships. This was attributed to the past neglect of the agricultural services by the Australian Government and the failure of the people of Australia to appreciate the need for agricultural research.

Generally speaking, the discussion on training and recruitment was disappointing. It is true that much that needs saying has been said several times already in the past twelve months at gatherings of Imperial delegates, so that it was difficult to escape the platitudinous But since every representative of the Home Government present subscribed to the view that the Imperial Agricultural Research Service must provide an attractive career for first-classmen, if it is adequately to fulfil its prescribed functions, it is reasonable to expect that they should have defined its attractiveness in specific terms, and stated what further financial provision the Government is prepared to make, and what financial support has been promised or is expected from the Dominions and non-self-governing Dependencies, for the effective carrying out of the schemes submitted to the delegates for their consideration. It is to be hoped that some definite statement of this character will be made before the break-up of the Conference

# Cambridge under the New Statutes.

THE Vice-Chancellor, in his recent address at the commencement of the academic year at Cambridge, referred to the heavy strain which has fallen during the past year upon the administrative officers of the University—the Registrary, the Secretary of the General Board, the Treasurer, and, we may add, the Vice-Chancellor himselfand upon the members of various boards and committees. When 1000 pages of ordinances have to be recast to meet the requirements of new statutes, the labour involved must necessarily be extremely heavy. It may not be without interest to inquire after a year's working how far the results obtained justify not only last year's work, but also the heavy work involved over a period of years by the labours of the Royal Commission and the subsequent Statutory Commission.

What are the gains of the new scheme? The first one that strikes the eye at once is the feeling of security that the younger married 'don' has gained through the existence of a pension scheme of the same type as holds in the other universities of Great Britam. This means a comparative freedom from serious financial anxiety, and it makes easier the free interchange of teachers between Cambridge and other universities. Coupled with this is the advantage to the University which must accrue from a scheme which ensures the retirement of the teaching staff on reaching an age limit. Opinion will vary as to the proper age for retirement and the benefit that comes from a rigorous compulsory scheme, but it is clear that the scheme is, on the whole, a definite improvement on the old order of things.

Financially, many teachers in the University also benefit by the increased stipends which the annual grant to the University secured by the Commission has made possible. University stipends still lag behind the corresponding figures for professional careers outside, but the disgrace of the charity pittance awarded in the past to distinguished teachers has been stopped. It is for the University to watch that fresh developments are not marred by inadequate financial arrangements. This may check some of the valuable growths which in the past have come from poor beginnings; an

enlightened policy should see to it that such growth should be encouraged but with a start on a better basis.

The real gain of the Commission is that the University has now secured control of the development of its educational policy to an extent that was impossible before. The General Board of the Faculties, with its control over the finances of the purely teaching side of the University, has become the most important body in the University faculties, acting through their appointment committees, have control of the appointment of new teachers and are not so dependent as before on the chance appointment by the colleges of members of college staffs It is significant of the change how many of the vacancies of the past year in lectureships have been filled by candidates from outside This widening of the field must be a Cambridge pure gain to the University.

This would not be the case if the chances of promotion of the best sons of Cambridge to office in the University were blocked by the new scheme It may be that the process of co-operation between faculties and colleges in making their staff appointments has not yet been fully explored. The ideal scheme by which the University and the college should each take its share in supporting the man who divides his time between the two of them may take some time to hammer out, but the new statutes make such a scheme possible and practicable. Goodwill and organisation will do the rest.

Among other gains requiring mention are the opening of most University prizes, scholarships, studentships, and teaching posts to women, the improved financial position of the University Library, the easing of University taxation on the smaller colleges—here it must be admitted at the expense of the larger and richer foundations—and the official recognition of research as part of the University's duty.

There are necessarily difficulties, and here and there doubts and regrets. It is incumbent on those responsible not to let organisation become dominant and not to press the professors with too much departmental administrative work. The Vice-Chancellor, we believe rightly, attributed the comparative lack of discussion of recent changes in the ordinances to "a disposition to settle down to work and to put the new Statutes of the University and the Colleges to the test of practice." The University may well spend a year or two in rounding off the fruitful work of the Commission and making quietly the further changes which experience shows to be desirable and necessary.

No. 3024, Vol. 1201

#### Catalysis.

(1) Die Katalyse in der organischen Chemie Von Paul Sabatier Nach der zweiten franzosischen Auflage, übersetzt von Dr. Berthold Finkelstein Mit einem Literaturnachweis für die Jahre 1920 bis 1926, bearbeitet von Dr. Hans Hauber. Pp. xi+466 (Leipzig Akademische Verlagsgesellschaft mb. H., 1927) 24 gold marks.

(2) Catalysis in Theory and Practice. By Eric K Rideal and Prof. Hugh S. Taylor Second edition. Pp. xv+516. (London: Macmillan and Co, Ltd, 1926) 20s. net.

YATALYSIS is a subject which has always excited the interest of chemists-sometimes, indeed, their prejudices and passions. There is one point, however, on which they are probably all agreed, namely, that the association between the catalyst and the substances the reactions of which it catalyses is of so specific a nature that it is proper to apply the term 'chemical.' On the other hand, to understand the mechanism of the large class of chemical reactions which take place in contact with solid catalysts, it is necessary to inquire into the physical nature of the interfacial region where the surface catalysis takes place, and this introduces all the phenomena of 'adsorption.' For some purposes it is more important to know about the adsorption equilibria than about the nature of the forces which hold the adsorbed molecules to the surface; and there has occasionally arisen a quite unnecessary distinction between 'chemical' and 'physical' theories of catalysis. In recent years, however, Langmuir has done much to dispel the idea of any such antithesis.

The truth about eatalysis has many aspects, one or other of which becomes of predominating importance according to the problem under consideration

There are two great objects: one is to arrive at an understanding of the nature of chemical change in general, and the other is to be able to control specific reactions for particular ends, possibly industrial. The two books under review are quite different in scope and method. That of Rideal and Taylor is of a quite general character, and deals with both the chemical and physical aspects of catalysis and with its industrial applications, that of Sabatier is written entirely from the specific chemical point of view.

(1) "La Catalyse en chimie organique" is already well known to most chemists either in the French edition or in the English translation by Prof. Reid. It is an inexhaustible source of Enformation about the multitudinous organic reactions which can be catalytically controlled. These reactions must be regarded as forming almost a separate branch of chemistry, and one which is becoming yearly more important. It is only necessary to think of the convenient catalytic process for the dehydration of alcohol to ethylene, compared with the traditional procedure, to understand what industry owes to catalytic chemistry.

It is often possible to make at least a shrewd guess at the kind of catalyst which will be most effective in provoking some desired reaction. Although most of the information about catalytic organic chemistry is purely empirical, nevertheless the rague outlines of general laws are in places dimly discernible Definite rules, which would enable catalytic influences to be predicted a prion, cannot of course be formulated, but Sabatier succeeds in bringing many hundreds of reactions into a degree of co-ordination which is surprising. The picture he presents is not more chaotic than that, say, of inorganic chemistry fifty years ago. The analysis and arrangement of the material is masterly, and admiration is increased by the reflection that a very large portion is derived from Sabatier's own researches.

It is interesting to read the statement that Sabatier's own work on catalysis has been guided by the hypothesis that unstable intermediate compounds between the reacting substances and the catalyst are always formed. In the introductory part of the book, which occupies about fifty pages, he develops a general theory based upon this idea, and shows convincingly the fundamental part played by specific chemical interaction. This aspect is a very important one, indeed all-important, since Sabatier is concerned solely with the nature of reaction products, and not at all with the kinetic problems connected with the mechanism of reactions, or with the relation between reaction rate and concentration. To deal with these, however, it would have been necessary to take into account the physical chemistry of the processes in a manner similar to that of Langmuir and others.

For the purposes of his treatment, then, Sabatier has quite rightly laid all the stress on the specific chemical influences; but it must be remarked that for the physical chemist in search of examples on which to test his theories, this book provides the best storehouse of raw material that could be imagined.

After three introductory chapters of a general nature, there follows a classified survey of different

types of reaction, beginning with isomerisations, polymerisations, and condensations. The following chapters deal in order with reductions, hydrations, hydrogenations, various decompositions, dehydrogenations, dehydrations, the decompositions of acids and esters, the splitting off of halogen hydrides, the decomposition of hydrocarbons, and the hydrogenation of fats.

The translation of the French text appears to be accurate, if here and there very slightly on the side of freedom, and the German edition possesses an index, the absence of which was an almost intolerable disadvantage of the original. This disadvantage is specially felt in what is in some respects a work of reference. The translation contains 83 pages of additions, covering the years 1920–1924, and a synopsis, not very complete, of papers which have appeared since 1924. In the theoretical part of this appendix are two scanty references to 'Longmuir.'

(2) Since the original edition of 'Catalysis in Theory and Practice' was published, considerable advances in the theoretical aspects of the subject have been made, and industrial applications have developed and multiplied. The theoretical parts have been completely re-written for the new edition, and much additional matter relating to modern developments on the practical side has been put in.

Two introductory chapters deal with the early history of catalysis, and 'criteria of catalysis.' Then general theories about the nature of chemical change are discussed under the headings 'Homogeneous Reactions,' and 'The Theory of Heterogeneous Catalytic Reactions,' homogeneous reactions providing a standard with which catalytic reactions may be compared and contrasted. The subjects of promoter action and catalyst poisons are then dealt with, after which various chapters deal with the applications of catalysts to processes of oxidation, hydrogenation, and so on.

To the reviewer the most interesting parts of the book are, perhaps, those dealing with technical processes. There is, for example, an excellent discussion of the general problem of the reduction of the oxides of carbon, with an account of the modern methods of producing methyl alcohol from water gas. In this, and other similar examples, the authors have shown the application of the theoretical principles to practical problems in an illuminating way.

Information is to be found in different parts of the book on such varied matters as the cracking of oils, the production of synthetic rubber, the hydrogenation of fats, and the production of aniline black.

It is always a difficult problem, in a book which aims at completeness, to decide how far the author should merely quote the work and views of others, and how far he should criticise and re-interpret On the whole, Rideal and Taylor have compromised well between the possible extremes.

No book dealing with a rapidly developing subject could be written every page of which would compel unqualified assent On p 82, for example, it is stated that to account for proportionality of reaction rate to a fractional power of the pressure in a heterogeneous reaction, it is necessary to assume that each molecule of one of the reacting gases occupies some definite integral number of elementary spaces on the lattice of the There is a much simpler explanation solid. When the degree of adsorption of a gas like stibine is large, the rate of its chemical change is independent of the pressure; when the adsorption is small, the rate is directly proportional to the first power of the pressure. For intermediate degrees of adsorption, therefore, the rate of reaction must vary as some fractional power, which, in point of fact, is never quite constant.

The production of the book is very good indeed It is perhaps a pity that more care was not taken over proper names; it was, for example, 'Knietsch,' and not 'Kneitsch,' who did pioneer work on the contact process, and 'McC Lewis' is rather colloquial. These minor blemishes should be removed when possible from a book which will be of importance to all chemists for some time to come.

#### The Calculus of Tensors.

The Absolute Differential Calculus (Calculus of Tensors). By Prof. Tullio Levi-Cività. Edited by Dr. Enrico Persico. Authorised translation by Miss M. Long. Pp. xvi +450. (London and Glasgow: Blackie and Son, Ltd., 1927.) 21s. net

DHE "Lezioni di calcolo differenziale assoluto" by Prof. Levi-Cività were published in Italian in 1925. This account of the foundations of the absolute differential calculus has now been translated into English. Miss Long has thus conferred a benefit upon British mathematicians for which they will be very grateful. The subject is of fundamental importance in the applications of mathematical methods to modern theoretical physics the treatment is as masterly as can be expected, coming as it does from the lecture notes of one of the out-

standing exponents of the subject and one of the outstanding contributors to its development, the translation is excellent, combining, as Prof. Levi-Cività says in the preface, "scrupulous respect for the text with its effective adaptation to the spirit of the English language"

It is more than a mere translation, however, that we have before us now More than 150 pages are devoted to two new chapters, written specially by Prof Levi-Cività, dealing with the fundamental principles of Einstein's general theory of relativity, including as a limiting case the special theory, as an application of the absolute calculus. More than one-third of the book is therefore new, and it is a privilege to British mathematicians to have this addition to the original contents published in the English language. This treatment of the theory of relativity possesses distinctive features, which give it added value. The present writer has tor a long time thought that the study of relativistic mechanics should be presented on the basis of the classical Newtonian mechanics. This would have obvious advantages, the most important being that the essentials in the transition from the conceptions in the classical dynamics to the conceptions in the relativistic dynamics could be presented clearly and effectively, instead of being lost in a maze of optics and electromagnetics. Further, it is surely reasonable to claim that the study of the spacetime manifold is fundamentally a kinematic exercise, although the causes which have led to the modern view of space-time are derived from astronomical, optical, and electromagnetic experiences.

Prof Levi-Cività has adopted this viewpoint. He traces the relativistic evolution of mechanics, including geometrical optics, which in the theory of relativity is based upon the conception of a light ray as a special case of the path of a massless particle. He also adds another distinctive characteristic in the fact that he does not lay down the postulates of relativistic mechanics in abstract form, as so many new laws introduced arbitrarily, but proceeds inductively from the classical mechanics to discover modifications which are forced upon us if we take account of the principle of relativity.

Starting off with Hamilton's principle for the motion of a free particle, Prof Levi-Cività first shows that it is possible to apply the same treatment to the time co-ordinate as to the three space co-ordinates of the particle, with reference to the variational equation  $\delta \int \mathbf{L} dt = 0$ . Introducing the form  $\mathbf{L}/c^2 =$ 

$$1 - \sqrt{1 - \frac{v^2}{c^2} - \frac{2U}{c^2}}$$
, which for a very large value of  $c$ 

veis approximately the same as  $L = \frac{1}{2}v^2 + U$ , the classical form of the Lagranian function, the equation  $\partial_1 ds = 0$ is obtained, where  $ds^2$  can be expressed in terms of any four co-ordinates as a general quadratic form. The results of the special theory of relativity follow at once by putting U zero, and the author deduces the Lorentz transformation and all its familiar consequences Further, the extension to spacetime manifolds differing from the pseudo-Euclidean space-time in the special theory is a comparatively simple conception, the world lines of a free particle being the geodesics in its space-time continuum. Particular attention is devoted to geodesics of zero length, or light rays, where s cannot be used as the independent variable. The equations of motion of a continuous system are obtained in the same inductive manner and the introduction of the energy tensor justified

Having defined the Einstein tensor and the gravitational tensor in the older form, with divergence zero, Prof. Levi-Cıvıtà writes down Eınstein's equations of the gravitational field (without the cosmological term) He at once proceeds to deal with the statical problem, thus separating the timelike from the space-like terms, and shows how to a first approximation the Newtonian field is obtained. After the crucial phenomena 'the author attacks the problem of fields having spherical symmetry, dealing with the Schwarzschild, the Einstein, and the de Sitter solutions, and introducing the cosmo-No reference is made to Einstein's logical term new form of the equations of the gravitational field, which does not affect the field in empty space, but introduces modifications into the field inside matter.

Of the large number of books that have appeared in the English language on the theory of relativity, very few have had anything very original to contribute Prof. Levi-Cività's book in its English translation is a notable addition to the literature of relativity.

S Brodetsky.

#### Two Vienna Biologists Abroad.

Im Lande der aufgehenden Sonne. Von Prof Dr. Hans Molisch. Pp. xi+421. (Wien und Berlm: Julius Springer, 1926.) 24 gold marks.
Amerikafahrt: Eindrucke, Beobachtungen und Studien eines Naturforschers auf einer Reise nach Nordamenika und Westindien Von Prof. Othenio Abel. Pp. ix+462. (Jena: Gustav Fischer, 1926) 24 gold marks.

BOTH these books are by Viennese biologists, who describe their observations during tours of one to Japan and of the other to America.

Prof. Molisch was from 1922 until 1925 on the staff of the Botanical Section of the Biological Institute of the Sendai University in Japan He has already, ın his 'Pflanzenbiologie in Japan, recorded his special observations, and in this book writes of his journeys to and fro and in Japan, as he puts it, as a "globe trotter." He is, however, a highly trained, skilled observer, and he writes an interesting account of his vovages out and home, and of the various phases of Japanese life. He describes, amongst other topics, life and sports at the Japanese universities and schools, the theatre, the magic mirror, fishing by cormorant, the hot springs, the ascent of Fujiyama, the aboriginal race—the hairy Amu, the earthquake of 1923, and Japanese horticulture, fruits, and vegetables.

Prof. O. Abel's account of his visit to the United States and some of the West Indian islands in 1925, at the invitation of the International Education Board, contains more original matter. He is professor of palæobiology and visited many localities famous for their evidence on geological ecology, and he expresses on their problems a competent, independent judgment He visited the American museums rich in fossil vertebrates, he examined the quarries in Connecticut famous for their Triassic footprints; his visit to the mangrove belts in Florida and the West Indies leads to the conclusion that the Flysch of the Alpine belt, which has been regarded as the deposit of mud volcanoes or of deep seas, is the mud of ancient mangrove swamps, deposited when Central Europe consisted of a group of islands and had a tropical climate; in Florida he examined the beds at Vero which have yielded remains of fossil man, and concludes that the man was not as old as the associated fossils; he discusses the West Indian fauna and explains the various continental visitors to the islands not by land bridges but by mangrove bridges, and his interesting chapter on this problem illustrates the extent to which biologists, whose conclusions depend so largely on negative evidence, overlook the direct tectonic evidence. In Western America, Prof Abel visited the Grand Canyon and the Brea deposit at Los Angeles which has yielded such a rich Pleistocene mammal fauna, and also the fossil quarries of Nebraska; there he also examined Dæmonelix, an obscure fossil which has been regarded either as due to a burrowing animal or to plant roots; and he advocates the latter

Both books are richly illustrated by excellent photographs, and many of these by Prof Abel are of the specimens he collected. He gives many references to the literature, so that the book is a useful guide to recent contributions to many problems in American geology. In his account of the bone beds of Nebraska he explains their origin by the crowding of the animals on to hill-tops at times of flood: and in reference to the opposite explanation, that they were bogged beside drying pools in time of drought, he quotes a sentence which he attributes to W. K. Gregory instead of to the present writer.

J. W. G

#### Our Bookshelf.

Eolus: or The Future of the Flying Machine. By Oliver Stewart. (To-day and To-morrow Series.) Pp 96 (London: Kegan Paul and Co., Ltd; New York. E. P. Dutton and Co., n.d.) 2s. 6d. net.

THE ' To-day and To-morrow' series has a reputation of brilliance and provocativeness. Mr. Oliver Stewart's account of the future of the flying machine amply maintains this reputation. The writing is clever, the argumentation is fearless, and the prophecy is unhampered by any hesitation to speculate on the barest foundations. In civil aviation, Mr. Stewart foresees a severe struggle between the present-day type of fixed-wing aeroplane and the moving-wing flying machine of which the autogyro is a forerunner. He concludes that the moving-wing type will prevail for short-distance flight, while the fixed-wing machine, in the form of monster flying boats weighing a thousand or more tons, will prevail for long-distance and transoceanic flight. An amusing forecast of the relationships between the police and sporting aviation is followed by a fantastic and gruesome account of the future battle in the air round and over London. Why has nobody yet written on the renewed sense of dignity and privilege that the provincial will acquire as the result of the concentration of aerial warfare round the large centres of population?

Mr Stewart seems to have considerable objection to statesmen and financiers. It may be of interest to scientific workers to discover that the author objects to them too: "... scientists have demonstrated that the world is flat, that it is round, and that it is oblong. In the future they will demonstrate that it is rectangular." This is pretty nonsense, and the author bases much of his interesting prophecy on the results of scientific investigation. Mr. Stewart does not believe in the future of the airship.

S. B

Theory of Vibrating Systems and Sound. By Dr. Irving B. Crandall. Pp. x+272 (London: Macmillan and Co., Ltd., 1927.) 20s. net.

The reader of Rayleigh's classical treatise on the theory of sound cannot but feel that the subject is more of theoretical than of practical interest. It is true that the theoretical results have many illustrations in certain of their musical and technical aspects, but one does not feel that the theory has had much influence on the design work of the constructional engineer. In recent years, however,

great progress has been made in applied acoustics, more especially in connexion with the problems of telegraphy, telephony, sound transmission and reproduction, and certain parts of the classical theory have been extensively employed to analyse and explain the problems and results that presented themselves in the technical developments of these subjects

In the book before us, the late Dr. Crandall, who was a member of the technical staff of the Bell Telephone Laboratories in New York, has presented an account of those parts of the theory which have proved of service to the constructional designer The theoretical side of the subject is treated thoroughly—on the lines of Rayleigh's treatise—without, however, too great insistence on mathematical detail, but also without that slovenliness and circumlocution so familiar in technical works dealing with mathematical subjects The best parts of an altogether good book are those essential connecting links in the mathematical argument where the physical assumptions underlying the theory are examined from the point of view of their practical possibility and where the limitations and usefulness of the mathematical results are discussed in their physical and technical bearing. To a theorist these parts make very satisfying reading, and to the practical man they more than justify the application of somewhat complex mathematical analysis to the technical problems of the subject.

The book is well written and can be strongly recommended as an up-to-date text-book of the subjects with which it deals. It is replete with bibliographical references even of the most recent developments of the subject, and is produced in a style worthy of the publishers' name that it bears

GHL.

Crashing Thunder: the Autobiography of an American Indian. Edited by Paul Radin Pp. xxvi+203. (New York and London · D. Appleton and Co., 1926) 10s. 6d. net.

This autobiography of one of the Winnebago Indians living on the Nebraska side of the Missouri River, is a remarkable document. It may be regarded either as a piece of anthropological evidence or as material for psychological study. Its engaging frankness and entire absence of a moral viewpoint are illuminating. At the same time it must be admitted that from neither point of view do the conditions which this record reveals seem such as are conducive to the welfare and preservation of the Indian, if they can be regarded as typical. It is perhaps significant that m seventeen years a Presbyterian mission had in 1909 converted one family only. This suggests a conservatism which adds to the value of the autobiography as a record of tribal custom and tradition. Anthropologists who have worked in the field are well aware of the difficulty of getting at the subjective side of the information they seek. In this document custom, ritual, and belief take their proper place as integral elements in proper perspective in the everyday life of the individual.

#### Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

# Radioactive Haloes. Possible Identification of 'Hibernium.'

Some years ago, Prof. Joly (Proc. Roy Soc., A, 102, 682, 1923) discovered radioactive haloes which could not be a scribed to any known radioactive product. One class, not unlike thorium haloes, he called X-haloes: a second class, of radu less than those of other haloes, he called 'hibernium' haloes, hibernium being the suggested name for the new radioelement causing the halo. Recently, S. Ilmori and J. Yoshimura (Sci. Papers Inst. Phys. Chem. Res Tokyo. 5, 11; 1926) have found a class of haloes not unlike X-haloes which they call Z-haloes. They suggest that the X-haloes and possibly the haloes ascribed by Prof. Joly to radon are identical with these, and that they are due to products of the actinium series. Z-Haloes have sometimes two inner rings smaller in radius than any caused by a known radioactive product, and these they ascribe to two uranium isotopes at the head of the actinium series with half-value periods of the orders of 1012 and 1023 years. They also state that their work on Z-haloes definitely establishes that the actinium series originates independently of the uranium series

The Japanese workers are, I think, probably right in their ascription of the Z-haloes to actimizing products, but in identifying radon haloes with actimizin haloes, and in ascribing the two very small rings to isotopes of uranium, they have missed an important point. The actimizing series cannot be regarded as originating independently of the uranium series in view of the strong experimental evidence to the contrary. Moreover, if the actimizing series has uranium isotopes, as they suggest it has, how did these get separated from uranium itself to form a halo unmasked by that due to uranium and its products? They have evidently not considered this. The only answer I can suggest is that the uranium isotopes which originate the actimizing series giving the Z-haloes are end-products of elements of atomic number greater than 92 and so have not necessarily mixed with ordinary uranium.

I think the explanation of the unexplained rings and haloes is probably simple and involves two things. isolation of radioactive products from known minerals by chemical agencies, and the possession of feeble radioactivity by some of the so-called end-products.

It is known (W. Marckwald and Russell) that uranium minerals may be so altered by agencies like percolating water that, while the presence of the equilibrium amount of ionium testifies to their great age, they are anomalous in possessing no lead, a fraction only of their equilibrium amount of radium and, as unpublished work of nune shows, a fraction only of their protoactinium Let us consider what is likely to occur if each of the different elements present in a primary uranium mineral were isolated by chemical agencies and afterwards formed a halo in the mica with the particles they emit. Isolation of element 91 would isolate protoactinium and lead to the formation of the halo characteristic of the actinium series; isolation of elements 90 and 88 would lead to uranium haloes in different stages of development, isolation of element 89 would lead to actinium haloes minus the

ring due to protoactinium; isolation of element 86 would lead to the characteristic radon halo discovered by Prof Joly, isolation of elements 84 and 83 would lead to a single ring characteristic of polonium; isolation of element 82 would perhaps lead to the polonium ring and to any rings due to possible a-particle activities from the end-products; no halo is to be expected from the isolation of the quick-changing products of element 81. Thorium minerals may be similarly considered

Now it is not unlikely that some of the end-products of atomic number 82 may be found to be feebly radioactive For theoretical reasons too lengthy to be given here I find that possible end-products of atomic masses 204, 205, 206, and 207 are unlikely to possess any radioactivity, while those of masses 210, 209, and 208 may be feebly radioactive, and that, of these three, actinium-2, of mass 209 (NATURE, Sept. 17, p. 402), is likely to be more unstable than the two others. Now, for a given half-value period, an 'α-rayer' of the actinium series has a larger range than an 'a-rayer' of the thorium or uranium series. The a-particle from the product of mass 209 might therefore be expected to have a longer range than those from the two other products, but shorter than the a-particles from uranium or thorium.

The identification by S. Limori and J. Yoshimura of Z-haloes with X-haloes was made, not by a comparison with their own of Prof. Joly's published measurements, but from observations of his photographs. (The published measurements of both sets ot haloes do not, in fact, agree well ) For a reason I know not, the radu of the rings of uranium and thorum haloes measured by the Japanese agree closely with those to be expected theoretically, while those of Prof Joly are generally smaller, the deviation from theory being the greater the shorter the range of the a-particle A straight-line relation appears to connect the theoretical with his observed radu of the rings, and, using it, I have calculated the radii of the rings of Prof. Joly's unexplained haloes to compare them with the other measurements. The smallest rmg observed has then a radius of 7, 5 4, and 6.3  $\mu$ in hibernium-,  $Z_1$ -, and  $Z_2$ -haloes respectively, and the second smallest ring has a radius of 11.0, 10.5, 10.8, and 10.7  $\mu$  in two different sets of X-haloes, in a  $Z_1$ -halo and in an unnamed halo respectively. Each of these rings is too small in radius to be ascribed to any active radioelement. The larger of these I ascribe to actinium- $\Omega$  (mass 209), and the smaller to both radium-\(\Omega'\) (mass 210) and to thorium-\(\Omega\) (mass 208).

On this view, if lead alone were isolated from a uranium mineral, a single ring, the larger of the two small rings, would be observed, since the concentration of radium- $\Omega'$  relative to that of actinium- $\Omega$  is very small. This would explain Prof. Joly's unnamed halo, the single ring of which has a radius of about 10 μ. Similarly, if lead alone were isolated from a thorium mineral, the smaller of the two rings would be formed. This would explain the hibernium ring. If protoactinum were isolated, the resulting haloes would have rings characteristic of protoactinium and its products without either of the smaller rings. This would explain the majority of  $Z_1$ - and  $Z_2$ -haloes. If lead and protoactinium were simultaneously isolated from uranium minerals, the resulting haloes would show the rings of protoactimum and its products and the larger of the two small rings. This would explain the X-haloes. If, finally, the uranium minerals contained thorium, as many of them do, there would be, in addition to the actinium rings, the smaller of the two small rings. This might explain the remainder of the  $Z_1$ -haloes.

I do not stress these identifications at the moment,

but I submit that the two points stated above afford a solution of these unidentified rings more probable than the ascription of Z-haloes to undiscovered and unlikely radioactive products and, as S. Rosseland (Nature 109, 711: 1922) suggested, of hibernium to an element of atomic number approximately 40.

If these views are correct, the disintegration series are partly extended to the element mercury. Inbernium is identified as thorium- $\Omega$  (or one of the two thorium- $\Omega$ s), the half-value period of actimum- $\Omega$  calculated from Geiger and Nuttall's relation is of the order of  $10^{16}$  years.

A. S. RUSSELL.

Christ Chuich, Oxford, Sept. 16.

#### Changes in Herring Shoals.

After the War, extended herring investigations were commenced at Cullercoats, and since 1919 there has been a continued series or observations as to the size, age, sexual development, and growth of the fish from some of the most important shoals in British waters. It is possible to point to three well-defined changes in the shoals, and the evidence from growth data indicates that these have been brought about by migration. There is a possibility that these migrations have been due to hydrographic conditions

Towards the end of 1920 there was a movement of some of the North Sea herrings to or towards oceanic conditions This movement was continued in 1921, in which year the whole of the east coast fishery was a failure (Reports, Dove Marine Laboratory). The years 1920-21 were marked by an abnormal invasion of Atlantic water into the North Sea. In 1923 the migrants of 1920-21 returned as spring spawners to the grounds off the north of Scotland and about the Shetlands; some few made their way so far south as the Berwickshire coast. Their scales showed a North Sea growth for the first three years and an oceanic growth for 1921-22. In the same year old fish, six winter rings and more, practically disappeared from the shoals of the north of Scotland, Shetlands, East Anglia, and north-west Ireland; the scales of fish from Howth, the Smalls, and St. Ives indicated extended migrations (*ibid.*). The white fishery was poor on practically all our fishing grounds.

Johansen directs attention to an abnormally strong inflow from the Skager Rack to the Kattegat in the spring of 1923 (Jour. Con. Per. Inter. Explor. de la Mer. vol. 1, No 2) and to increased catches of mackerel from Danish waters (Medd. Komm. Harund., Fisk., Bd. 7, No. 8). Watkins, in his report on Cardigan Bay shoals, quotes Lloyd as to the invasion of Cardigan Bay by oceanic forms in the summer of 1992.

1923.

In January 1926, extraordinary numbers of young fish (1924 year-class) appeared off north-west Ireland, and trade papers reported the invasion of the lochs of western Scotland by shoals of small size and poor quality. About the north of Scotland, the 1920 year-class and younger fish failed to appear in sufficient numbers to make anything but a poor spring fishery, and the same applies to the Berwickshire coast (Repts., Dove Mar. Lab.). In August there was an exceptionally good fishery off the Northumberland coast. Following this we have to note a marked difference between the shoals of north-western Ireland and northern Scotland in the early months of 1927. Previously the relative values of the different year-classes were the same for these grounds, but now the 1923 year-class is predominant about northern Scotland and that of 1924 about north-western Ireland. In Shetland waters the year-

classes which had been good previously are now poor, and the poor year-classes are good. This is illustrated by the age composition of two samples given below.

#### WINTER RINGS (PERCENTAGES).

The Northumberland shoals have been marked this year by abnormally high percentages of fish with 2 winter rings. They are a year vounger than usual Reports from friends in the herring trade state that from Wick to below Scaiborough the fish have been small It will be of interest to see if the East Anglian fishery is marked by large numbers of young fish in October and different relative values of the older year groups later in the season.

It is evident that the herrings have been swimining differently and the large catches of salmon off the Tyne 1926-27, and the taking in August off the Tyne of cod more than 40 lb when gutted, suggest that

other fish have been doing the same

The Dana in August 1926 took 297 larval eels from the southern part of the Faroe-Shetland channel, and Schmidt (Jour Con Per. Inter. Explor. de la Mer, vol. 2, No. 1) gives these an age of  $2\frac{1}{1}$  to  $2\frac{1}{2}$  years. The International Ice Patrol reported for 1924 an absence of ice and fog, warmer water than usual—5° to 6° F. above normal in March—over the Grand Bank Region, and for the first time a complete cessation of the flow of Arctic water southward along the east side of the Bank during the ice season. The Annual Report, Department of Marine and Fisheries, Newfoundland, 1924, states that Labrador cod were on the grounds before the fishermen were ready, and that whilst the southern Labrador cod fishery was poor, that of northern Labrador was excellent Huntsman ("The Ocean around New-toundland") records exceptionally warm water over the Grand Bank early in the season of 1924, cod farther in than usual on the banks off Nova Scotia, large quantities of haddock close inshore off Nova Scotia and New Brunswick, the failure of the cod fishery of the Belle Isle region, and the capeling farther north on the Labrador coast than ever before. Jensen ("On the Fishery of the Greenlanders" records for 1924 the presence of great quantities of large cod in Davis Strait in June, great shoals of small cod off western Greenland at the end of summer, and for the first time in seventeen years the presence of Gadus virens in Greenland waters From the statistics of the cod fishery given by Jensen, it would appear that in 1924 the cod population of western Greenland split, one half going north, the other south.

There is evidence that in 1924 the fish of the north-western Atlantic were swimming differently and that their movements were influenced probably by hydrographic conditions. The connexion between the happenings on the other side of the Atlantic in 1924 and changes in British waters, indicated by the herring shoals as beginning early in 1926, is perhaps worthy of consideration

At present the chain of events would appear to be as follows: An abnormal activity of oceanic waters in 1920-21 probably due to lunar influence; a cumulative effect or a rebound from the Arctic accounting for the happenings of 1923, the production of a mild Arctic winter, 1923-24; a diminution of cold currents entering the north-west Atlantic in the spring of 1924, followed by changes in the north Atlantic warm currents which influenced British waters and fisheries early in 1926. B. Storrow.

Dove Marine Laboratory, Cullercoats, Sept. 24.

# The Crystalline Nature of the Chief Constituent of Ordinary Coal.

The examination of thin sections of coal with the petrological microscope (see NATURE, Dec 25, 1926, p 913) has been extended to Terriary coals from Baluchistan, the Punjab Salt Range, and Assain. The observations previously inade on Paleozoic coals have been confirmed by the later investigations, except for the pleoch oism, which is deceptive and probably not actual

In every section which has been studied in ordinary transmitted light, practically all the bright coal and much of the dull coal layers seem to have the structure of polished wood and to consist of a madder-red coloured, translucent substance. If the section is thick or the illumination feeble, this substance is darker coloured or almost black. In very thin sections or with strong sunlight, this substance has a distinct golden yellow colour. Examined in plane polarised light, all sections show an exceedingly faint waxing and waning in the illumination of the coal substance throughout the movement of rotating the section. There is no definite darkening or lightening as a whole at certain positions, and thus pleochroism is evidently absent

Sections of bright coal cut parallel to the plane of lamination and examined between crossed Nicols show the coal substance to be isotropic. The section, although dark, is not absolutely dark between crossed Nicols Close attention, while rotating the section in this position, shows that every part of the substance goes absolutely dark at some point, but it lets a little light through in other positions. The total light coming through is, however, small, and the darkened section seems to be uniformly darkened even during the rotation of the slide. There is of course the same very faint continuous waxing and waning during the rotational movement, as was noticed for the illuminated section in plane polarised light.

All sections cut perpendicular to the planes of lamination and examined between crossed Nicols show the coal substance to have the crystalline character of a uniaxial mineral. The whole of the coal substance seen in the field of the microscope is moptical continuity as if parts of a single crystal. It has, on rotation of the section, a definite extinction, very distinct with really strong illumination, parallel to the lines of the laminæ. The extinction is not absolute at its darkest point, nor is the section very bright when the Nicols are at 45° to the laminæ. However, there is no doubt whatsoever about the extinction phenomena being quite clear in all the sections cut perpendicular to the coal laminæ.

The coal substance is seen to be somewhat granular under higher powers of the microscope. In some portions of the slides there is evidence of a cellular or woody structure. The presence of recognisable structure in the coal substance does not affect the optical phenomena at all. If a honey-comb was filled with opaline slica and a section made, the general appearance of the slice under the microscope would probably be similar. Stopes and Wheeler ("The Constitution of Coal," Department of Scientific and Industrial Research, 1918, pp. 20-21) have recorded an observation of this nature in the case of a piece of fossil-wood examined by them. The siliceous matter had permeated and filled the wood cells without destroying or replacing the tissues separating the cells of the original wood.

In addition to the main or chief constituent of coal, the section reveals the presence of three types of minor constituents: (1) Resinous bodies, (2) amorphous 'mineral charcoal,' and (3) morganic

matter Any one or more of these three minor constituents may be present in abundance and impart a distinctive character to the coal,  $e\,g$ , dull waxy or spore coal (bog head), dull silky coal, and coal shale being types respectively. Each of these minor constituents offers an attractive field for research. Their study is far more complex than the simple names suggest

The discovery that the chief substance or constituent in ordinary coal was probably liquid or a fluid jelly which has afterwards hardened affects the existing nomenclature of coal constituents. No terms based on lithological characters (e.g. vitrain, clarain, and durain) or on a botanical origin (e.g. anthraxylon and attritus) can have more than a descriptive significance. Such names may be convenient if restricted to the appearance or structure, respectively, of the coal, and not extended to the nature of the coal substance. The older, well-known terms, bright coal, dull coal, and mineral charcoal, with perhaps the introduction of such adjectives as silky, glossy, matte, waxy or resinous, and shaley, can be made just as explicit as any of the above terms for descriptive purposes. (See descriptions by Fermor, Memoirs, Geological Survey of India, vol. 41, pt. 2, 1914, pp. 180-181.)

A note of warning must, however, be sounded in regard to the naming of the chief constituent of coal. It is as certain as can be that this constituent permeates the coal and has crystalline properties suggestive of a definite substance. We are under no delusion that analyses of the purest forms of brown coal, bituminous coal, and anthracite clearly indicate a loss of carbon dioxide and methane from a composition, say, of dopplerite. There is little doubt that with loss of volatile matter the coal substance has not merely hardened, become denser and changed in appearance (lustre), but that there is an evident change in composition. Therefore in giving a name to this chief constituent we must remember this change of chemical composition. It would be simplest for the present, perhaps, to use the word coal substance, in a strict scientific sense, for the chief constituent of coal, using the general word 'coal' as it has always been used. CYRIL S. Fox.

Geological Survey of India, Calcutta, Sept. 7.

#### Origin of the Rio Tinto Ore Bodies.

AFTER a year's intensive study of the surface and underground conditions at the Rio Tinto Mines in the Province of Huelva, Spain. I have been led to a theory as to the origin of the great ore bodies in this region. As this theory or working hypothesis has already borne fruit, masmuch as it has led directly to the finding of several new ore masses, it is deemed worthy of brief mention here in advance of the full discussion which will appear later.

In the vicinity of the mines there are two masses of quartz porphyry. The southern mass is a sill which has been injected along the cleavage of the slate. To the north of this sill, and separated by slate, there is another porphyry intrusion which maps as a dyke. On its southern flank it either undercuts or reverses the dip of the slates. On its northern flank it has a conformable intrusive contact with slates, that is, the strike and dip of the porphyry-slate contact are the same as the strike and dip of the slaty cleavage. Within the porphyry area there are numerous isolated bands of slate. The North Lode group is entirely surrounded by porphyry. On the other hand, San Dionisio, Eduardo, and South Lode are on the south contact between porphyry and slate.

Planes is at the eastern nose of the dyke with immeral between its slate roof and the porphyry.

The porphyry, which is near a numeral mass, is fractured and also sheared. The shearing appears as an approximation to a rough irregular cleavage. The fracturing gives a coarse cross pattern and the fractures are now filled with pyrites, chalcopyrite, and gangue. The ensemble of these veinlets is called a stockwork.

The stockwork is always found below or to the side of the mineral, and extends both horizontally and vertically for considerable observable distances from the masses

I believe that the masses were fed from depth by the

solutions traversing these channel-ways.

In regard to the shearing and fracturing, it would appear that forces other than those usually termed orogenic, that is, large scale tangential compressive forces, must be called in to explain their origin. The reason is that any forces of sufficient magnitude to shear and fracture the porphyry would have pulverised the slates to a degree not seen in the areas around the dyke. It follows that one should look for the cause within the porphyry mass itself. Where stockwork is strongest there is less shearing and vice versa. Furthermore, the strike and dip of the shearing approximately parallels the contact of the porphyry and slate. These facts seem to indicate (a) that the shearing is the result of injectional pressure, and (b) that the shattering took place following the crystalhsation of the magma when torsional forces were brought into play by slight upward or downward movements of the semi-liquid magma beneath its chilled roof. Where a shear structure existed, the movement was taken up along the already existing lines of weakness, but where the magma had crystallised normally the result was a shattering. The pattern of the shattering on any plane resembles closely that which was produced by Daubree in his classical experiment on the torsional effects on a glass plate ("Etudes synthetiques de Géologie Experimentale." Paris, 1879.)

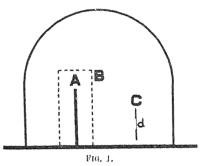
As the magma cooled, pressures were brought to bear on the interior of the porphyry mass and the mineral bearing solutions were caused to circulate upwards through the fractured zone. These solutions replaced the softened and communited state, which had suffered alteration by the intrusion of the porphyry, and to a certain extent the porphyry itself. It may be asked why all the slate at the slate-porphyry contact is not thus altered and therefore in a state favourable for replacement. The answer is that where the porphyry has cut across the slaty cleavage or where the porphyry has included keel-shaped masses of slate, it has had the opportunity of altering the slates. Where the porphyry has simply slid up along the slaty cleavage there has been little alteration, because the slate is almost impermeable to solutions in a direction normal to a cleavage plane.

G. VIBERT DOUGLAS Geological Department, Rio Tinto Mines, Spain, Sept. 1927.

#### The Electric Arc in High Vacuum.

Whatever the mechanism of the electric arc, we can scarcely expect an arc to strike and to persist under pressures so low as to render difficult the passage of a high voltage discharge. However, in the course of some experiments on the discharge of electricity through gases, it was observed that under certain conditions an electric arc carrying many amperes can be maintained in a vacuum as high as 0.001 mm.

The electrodes A, B, and C (Fig. 1) are placed under a large bell-jar of 12 litres capacity. Electrode A is a heavy rod or block of metal enclosed in B, an electrode in the shape of a box made of heavy metal gauze or perforated plate. Electrode C is composed of a circular plate and an insulated platmum. strip stretched across an opening in the plate; it may be used either as a cold electrode or as a Wehnelt cathode. Electrodes A and B can be connected to the 230 volt line, and electrode C to a source of high potential. When a vacuum is produced under the bell-jar and a high voltage discharge passed between C and B, an are strikes between A and B and keeps going after the auxiliary discharge is stopped. The higher the vacuum, the easier the are starts 0.001 mm, pressure, a p.d. of 60 volts across 4 and Bis sufficient to start the arc, at 0.05 mm 120 volts is necessary, while at I mm pressure a p.d. of 230 volts is not sufficient. During the passage of the are the pressure under the bell-jar naturally increases, but if the electrodes A, B, and C are previously freed from the occluded gases by a prolonged discharge



and the moisture in the vessel removed by phosphorus pentoxide, this merease becomes very small In one experiment, for example, an are carrying 3 amperes for 10 seconds raised the pressure to only 0.002 mm., and at this pressure, after the are had been interrupted, the high voltage discharge from electrode C still passed with difficulty, showing the characteristic green fluorescence on the walks of the bell-jar. The fact that with small potential differences practically unlimited currents can pass between electrodes A and B, while the low pressure makes it almost impossible for the discharge to pass from the electrode U in spite of the high potential applied, is very surprising, and indicates that the mechanism of the electric arc is radically different from that of an ordinary discharge.

The arc has been produced with copper, brass, ron, and aluminium electrodes. It shows the usual current-voltage characteristic, the p.d. across the electrodes dropping to about 20 volts when the current is increased to 30 amperes. When the arc strikes, a brilliant spot appears on the surface of the cathode and continuously changes its position as in

the case of a mercury arc.

An interesting feature of the arc is the unilateral relationship which the polarity of the arc must bear to the polarity of the auxiliary discharge between C and B. If C is an anode, the arc strikes independently of the direction of the field between its electrodes A and B, but when C is used as a cathode the arc strikes only when A is the anode in the arc circuit. This property of the arc has been successfully employed in some experiments in rectitying alternating current S. RATNER.

Physics Laboratories, Columbia University, New York, Aug. 30.

#### Coherence of the Reflected X-Rays from Crystals.

On Jauncey's theory (*Phys. Rev.*, **25**, 314; 1925) of the unmodified line in the Compton effect, an unmodified X-ray is scattered when the energy of the impulse imparted to an electron is insufficient to eject the election from the parent atom. In this case the impulse is presumably imparted to the atom The change of wave-length of the unmodified ray should thus be of the order of [(mass of the electron)/(mass of the atom)] x (change of wavelength of the modified line) It is generally assumed that no coherence occurs for modified scattering on account of the change of wave-length. In the case of unmodified scattering, however, it is assumed that coherence does occur, as, for example, in regular crystal reflection (see papers by Williams, *Phil Mag.*, 2, 657; 1926, and Jauncey, *Phys Rev.*, 29, 757; 1927) But how can coherence occur in unmodified scattering if there is a change of wave-length, however small? Perhaps there is no change of wave-length at all in unmodified scattering

Following the idea underlying Jauncey's interpretation of the unmodified line, the atom should not by itself receive the impulse of the scattered quantum unless the energy acquired from this impulse is sufficient to give at least one quantum of vibrational heat energy to the atom. According to Einstein's theory of specific heats, this energy is  $h\nu$ , where  $\nu$  is a frequency of the order of that of the reststrahlen from the substance in question The wave-lengths of two bands of these resistration from rock-salt are  $47\,\mu$  and  $54\,\mu$  (Wood, "Physical Optics," p 412), or, let us say, of the order of  $50\,\mu$  A quantum of this wave-length has an energy of 0 024 electron If we consider the  $K_a$  line of molybdenum reflected from the (100) planes of rock-salt in the  $n^{th}$  order, the energy of recoil given to a sodium atom by the impulse imparted by the reflected quantum is 0 0252 sm²  $\theta$  volt-electrons (see Compton, "X-Rays and Electrons," p. 267). Replacing  $\sin \theta$  by  $n\lambda/2d$ , the energy of recoil is  $4.02 \times 10^{-4} \cdot n^2$  volt-electrons Hence the ratio of the energy of recoil for each order to the energy of a quantum of reststrahlen is as follows:

 $\frac{n}{\mathrm{ratio}}$   $\frac{1}{0.017}$   $\frac{2}{0.067}$   $\frac{3}{0.15}$   $\frac{4}{0.27}$   $\frac{5}{0.42}$   $\frac{6}{0.60}$   $\frac{7}{0.82}$  The highest possible order of reflection according to Bragg's law is the seventh. The fact that the ratio is always less than unity indicates that the energy of recoil is always less than that of a quantum of thermal agitation, and this implies that the thermal agitation will not be excited. Presumably, therefore, the impulse is imparted to the crystal as a whole. There is thus no reason to anticipate an absence of coherence in the reflected rays.

This point of view leads naturally to the quantum interpretation of crystal diffraction as suggested by Duane.

Washington University, St. Louis.
A. H. Compton

University of Chicago, Sept. 1.

#### Spectrum of Ionised Krypton.

The lines of the spectrum of krypton which appear under the influence of condensed discharge, were first carefully measured by Baly (Phil. Trans, vol 202, p. 183, 1903). Messrs. L. and E. Bloch and Dejardin (Ann. de Phys, vol 2, 1924) have recently studied the spectra of krypton developed with electrodeless discharges, and re-arranged most of the lines given by Baly, and also many new lines measured

by themselves, into groups of spectra appearing with varying excitations. Following the analogy with ionised neon, the spectrum of which was analysed by me some time ago. I have observed that the spark lines of krypton which appear at the lowest excitation show a considerable number of regularities. I give below three groups of terms, A, B, and C, such that A combine with B, and B with C, and account for a large percentage of lines. The values given are purely arbitrary, the deepest level so far discovered corresponding to 0.

	A	
0		4774 4
$2263\ 6$		5645.7
	B.	
21094 9	$25550 \ 4$	28891 5
21457 7	262727	29164.5
22952 1	272880	295324
23240 1	$27306\ 1$	
	C.	
44247 5	48970 1	$50526\ 3$
45053 8	490457	51607.5
48577 4	492272	$52245\ 5$
48620 0	497342	$52310 \ 1$

I have not yet succeeded in identifying the natures of these terms unambiguously. Zeeman splitting of some of the lines holds out the best promise of success in this direction. P. K. Kiehlu.

Physics Dept., Science College, Patna, India, Sept. 14

## The Diminution in Number of the Nodes in the Bivalents of Lilium.

The species of Lilium examined have twelve pairs of long chromosomes. The numbers of nodes in the bivalents of Lilium longiflorum (and Lilium regale) were counted at different stages, from the earliest prophase, immediately after the diplotene stage, to the diaphase; and also at the metaphase itself. These counts were usually made after pressing cyto-plasm and chromosomes from the cell. Such counts showed that the average number of nodes for the group of twelve chromosome pairs was 22.1 for the diaphase and metaphase, while in the earliest prophase it was found to be 39. Thus nearly half the nodes (43 per cent.) disappeared between the diplotene In L. longiflorum, pollen stage and the diaphase. mother-cells observed at stages between the earliest prophase and the diaphase showed different degrees of diminution in the number of nodes. In the four largest chromosomes of Hosta carulea, a similar reduction was observed, from 9 to 5 nodes. From the drawings of Newton (Linn. Soc. Jour. (Bot.); 1927) it can be estimated that there was a loss of nodes between the earliest prophase and the diaphase of somewhat less than one-half the number in Tulipa.

The nodes at the diaphase and first metaphase can be proved, in all or nearly all cases, to be chiasmas. This can be shown in *L. candidum* by pressing the netaphase bivalents flat, when the X-chiasmas are clearly visible. The question is, then, what is the nature of the nearly fifty per cent. of the nodes which disappear before diaphase? The writer considers that the majority of these are not half twists; as has, perhaps somewhat hastily, been concluded by the early cytologists.

JOHN BELLING.

Department of Genetics, Carnegie Institution of Washington, Cold Spring Harbor, Long Island, N.Y., Aug. 23.

### Invention as a Link in Scientific and Economic Progress.1

By Sir James B. Henderson.

NVENTION and discovery are so closely allied that they are often confused. In our common speech the two terms are frequently used as synonymous, and if one seeks an exact line of demarcation between them one finds it difficult, if not impossible, to distinguish one from the other in any but the most general terms. Both involve an increase in knowledge which may be great or slight, and may have an immediate effect or may take a lifetime or more to consolidate Both involve scientific Each may be only a happy idea, imagination the inspiration of a moment or in some cases an accident, but the testing of the idea and its final enunciation as a physical truth or as a finished invention may occupy many years Newton is reputed to have discovered the theory of gravitation on seeing an apple fall from a tree, but assuming that to have been the birth of the idea, we know that the completion of his discovery and the proof of the universal law of gravitation took the best part of his lifetime and involved the invention of new branches of mathematics to complete the

The dividing line between discovery and invention is, in very general terms, the same as between theory and practice, between the abstract and the concrete. Discovery is essentially an increase in man's knowledge of Nature and its complexities, and is therefore intangible. It may be a discovery of a new principle, a new element, a new and hitherto unknown quality or characteristic of a known substance, and so on, but the discovery, per se, has no regard to any particular practical application of the new knowledge. Invention, on the other hand, has its sphere in the practical application of knowledge, and the knowledge used may be new or may be as old as the hills. It may be, and it is often the case, that invention involves other discoveries which may be complementary to the original discovery and form its completion, or may be entirely unrelated to it and form the nucleus of a new branch of study It is possibly this fact, that the difficulties encountered in developing an invention often lead to new discoveries, which makes it so difficult to separate discovery from invention. I think, however, that this distinction in general terms is sound, that discovery is mental while invention is material, and while it is true that in the large majority of cases an invention is in its origin a mental conception, it is a conception of something material and practical, while a discovery begins and ends in the realm of the mind.

When one seeks to study the history of some of the great inventions, one begins to realise how exceedingly complex they are, despite their outward appearance of simplicity. As an example, take wireless telegraphy and telephony. No single person deserves the credit for its discovery

and invention. Maxwell, Hertz, Lodge, Crookes, Branly, Marconi, Jackson, Fleming, de Forest, Fessenden, and many others have contributed their share to its development, but the basis of wireless communication did not necessarily begin with Maxwell.

Hertz was the first to produce apparatus for transmitting and receiving wireless waves, and this apparatus was improved by Branly, Lodge, and many others, but for further progress finance was needed. The firsts steps to make a wireless telegraphic installation were taken in Italy by Marconi and in Great Britain by the Admiralty experiments carried out by Admiral Sir Henry Jackson, who was then a captain In this kind of competition money counts for much, and in the development of an invention having a commercial as well as a service aspect, a commercial firm with good financial backing will always have a great advantage over a Government department with a strictly limited budget allowance for re-It says much, therefore, for the scientific search direction of the Admiralty of that time, that the Admiralty is to-day numbered among the pioneers of this great invention.

Wireless has been taken as a typical illustration. To the man in the street it represents simply an invention, a single invention and an apparently simple one represented by a small wooden box with a knob to turn. But to the scientific historian who tries to decipher all that the little box represents in human thought and effort, it presents an appearance of amazing complexity in which the discoveries and inventions of some of the finest brains of two centuries are inextricably blended.

#### INVENTION AS A HISTORICAL SCIENCE.

The science of invention is a curious blend of the exact sciences, like mathematics, physics, and chemistry, with a historical science. It is in many respects similar to the science of war, the war being against the complexity of Nature, man's ignorance of that complexity and the inefficiency and insufficiency of the human intellect itself.

Yet if we compare this contest with the wars of man with his fellow-man, what a difference we find. Napoleon said he learned the art of war from a study of the lives of the 'great captains,' but in the greater war with Nature, if we consult the books that have been written round the lives of its 'great captains,' we find only human documents in which the searcher after knowledge, to help him to carry the fight a little further, finds little help beyond an example of high courage. The technical difficulties are seldom recorded, and the new searcher has generally to start afresh and reconnoitre his way across the old battleground of centuries. The fault sometimes lies with the chronicler, but too often with the lack of records which the 'captain' might have left but

 $<sup>^{\</sup>rm t}$  From the presidential address delivered to Section G (Engineering) of the British Association at Leeds on Sept. 1.

failed to leave In fact, here we have a startling lesson from the science of war, for is it not drummed into every budding soldier until it becomes second nature when he attains command, that one of his first duties in the field which must never be neglected is to maintain communication and pass on all information that may come his way, whether it be useful to him or not? The lesson has two sides. The soldier knows that he may become a casualty at any moment and the information which he gleans may be of vital importance to enable some one else to carry on in his stead, also, that information which may appear unimportant to him may prove to be the key to the movements of the enemy elsewhere of which he is in entire ignorance

Of the hundreds of inventions which have been a and oned as failures, or of possibly revolutionary inventions left incomplete simply from lack of capital or lack of courage, no record is available to those who come after and might carry them on to success. Has every inventor for all time to start from scratch? The same difficulties crop up time after time in the development of inventions, yet every new inventor has to tackle the difficulties de novo, and fortunes are wasted in

the process.

Development of an invention is always costly. even when guided by all the experience obtainable from allied inventions, how much more costly it is when not so guided, the history of the failures would most surely show. In most inventions there comes a time when the inevitable question arises, 'Shall we cut our loss or risk further expenditure?' If the decision is to cut the loss, the invention, which is possibly a sound one and of great value, is pronounced to be a failure, and the result may be the loss of an industry to the country or a delay in its introduction for many years. Science will prevail in the long run, but the cost of the trials both in time and money could probably be greatly curtailed if records of similar ventures in the past were available. Invertors would gain much if they could be trained in, and benefit by, the experience of their predecessors in the same field, while masters of industry. with records of that experience before them, would be better able to appreciate the difficulties of the inventor and to co-operate fully with him.

In every industry one finds that the experience gained in developing the inventions of the industry is often guarded as a most valuable secret. The result is that this knowledge is not recorded and often dies with the individuals who possess it. Future workers even in the same industry have to pass through the same or similar experience to regain the lost knowledge and the whole condition is economically unsound. The expense to the nation which it entails must be enormous. It retards progress, it adds greatly to the time and expense of developing other inventions, and it brings invention into disrepute because so many firms have lost money in trying to develop inventions which have had to be abandoned simply through inexperience.

INVENTION AND INDUSTRY.

The history of the twentieth century shows clearly that invention is the heart of industry, the root of new developments, and the source of improved methods of production which have led to cheaper costs and a wider scope in every industry. It has also been the cause of some of the greatest social upheavals and strife. Innumerable strikes have arisen from it, and if there is one lesson in political science more potent than another to be learned from the history of such movements, it is that science is always victorious in the end. Progress may be delayed or an industry may be lost to a country temporarily or permanently by such strife, but the steady advance of the world's progress through the science of invention is certain. One country may lose, but the world will gain in It is only a question of time, and if the leaders of industry, both masters and men, would only recognise this fundamental truth, how much faster progress would be.

It must not be imagined, however, that every invention can or, from the commercial point of view, should be introduced into an industry the moment it is made. Quite apart from the time necessarily spent in developing and perfecting the invention, for which purpose many industries have now instituted research departments of incalculable value, it is sometimes found that the occasion is inappropriate or that the time is not ripe for the change involved The introduction of a new invention or of a new design may involve many complicated questions of policy or finance, because the change may have to be accompanied by heavy sacrifice in other directions, possibly affecting other industries or the public at large. There may have to be heavy scrapping of spare parts, There may also be considerable tools and plant loss to the customers of the industry through depreciation of the products of the industry already in use, for nothing depreciates a firm's production more rapidly than the introduction of

a new and superior model

Manufacturers have therefore, on some occasions, to collect and husband their inventions and improvements after testing their merits and keep them in reserve for a more opportune occasion. The opportunity may occur very suddenly. It may arise through a sudden whimsical change in fashion which no one can explain, or from some other cause which it has been impossible to anticipate, and if a manufacturer has no policy of improvement all worked out and ready to apply, he is faced with the awkward alternative of falling behind the times by making no change at all, or of risking his market by adopting some new model which he has not had sufficient time to test thoroughly. The former policy is almost always disastrous and the latter is often worse. Numerous illustrations of both these courses and their results could be cited from any industry. There inevitably comes to every industry a time when radical change is demanded, and the firm which is best prepared for the change reaps the reward of its foresight.

Industry when viewed in its international aspect determines the lives of nations. The nation which organises its industry most efficiently, which hampers it least and stimulates it most by legislation, or absence of legislation, and by its scientific foresight, is the nation which will prosper most. Since invention is the heart of industry, the inquirer naturally asks. Is this country doing its best to stimulate invention as a means to foster industry? Are the leaders of industry fully alive to the position which invention plays in industrial progress? Have our legislators ever paused to think that their functions are only called for because of the progress which has been made by scientific invention, and that without such progress they would be unnecessary; also that, in the past, legislation has done much to retard progress ? A study of the fundamental scientific causes of progress would form a useful addition to the education of legislators

#### INVENTION AS A LINK BETWEEN EXACT SCIENCES.

It is sometimes stated that the physics of to-day becomes the engineering of to-morrow. This is a natural development, since the engineer is more concerned than the physicist with the practical application of physical discoveries. But the converse is frequently true, for many physical discoveries and inventions arise from difficulties encountered by the engineer. The science of practical hydrodynamics is a case in point. The mathematical science of hydrodynamics has been of little service to the engineer in the practical problems of the propulsion of ships, in the complex phenomena of vortex motion associated with the flow of water and steam through turbines, or in problems of aerodynamics, with the result that the engineer has had to develop an empirical science of hydrodynamics to supply his immediate needs. A huge mass of experimental results in screw propulsion, in aerodynamics and in hydraulics has thus been accumulated and is now awaiting some discovery or discoveries in mathematics or physics to correlate it all. If vortices could only be dealt with like potatoes or any other form of merchandise, each a complicated physical system in itself but capable of being considered as a unit differing only in mass or in its energy contents, a forward step might be made. The Lanchester-Prandtl theory of lift and drift of aeroplanes is a first step in a particular case of the general problem. Such a discovery, when made, will be bound to lead to further advances and improvements on the engineering side of the subject.

Most discoveries in physics arise from some experimental fact discovered more or less accidentally. The discovery of Röntgen rays was accidental, and the enormous strides which have been made in our knowledge of the atom by J. J. Thomson, Rutherford, Bragg, Bohr, and many other physicists during the last thirty years have resulted from Rontgen's discovery combined with another great discovery in pure thermodynamics, Planck's quantum theory, which also arose from an accidental discovery made in the course of ex-

periment. The Reichsanstalt in Berlin had published a family of curves representing the distribution of energy in the spectrum of a hot black body. Prof. Wien by trial and error obtained an equation to the family, and the form of this equation was suggestive. Planck, in trying to develop this equation from the laws of thermodynamics, found that he could only do so by assuming that energy is not indefinitely divisible and he comed the term 'quantum' to represent the fundamental unit.

These two discoveries of Rontgen and Planck form the starting-point of that most important branch of modern physics which has increased our knowledge of the constitution of matter, a science which is just beginning to find its field of application in engineering practice, as in the thermionic valve and the modern power transformers on the same lines. From these and other applications

great advances are still to be expected.

In reviewing the discoveries in physics which have had most effect in developing new industries and thus calling forth new inventions, one is struck by the great results in this respect which have arisen from application of the second law of thermodynamies, first stated by Carnot in 1824. Carnot described his ideal heat engine and showed that the efficiency of this engine is independent of the working substance used. Looking back upon the history of the science of thermodynamics of the last century, it is unfortunate that no one seems to have employed this statement of Carnot's as a general text, and developed it to find what information could be derived from it by using different working substances and mixtures in order to discover something about all the substances used. Had any one done so, progress might have been greatly accelerated

James Thomson was the first to use this second law to determine the lowering of the freezing point of water due to pressure. His brother, Lord Kelvin, followed with the application to the change from liquid to vapour. Helmholtz used the voltaic cell as the working substance and determined the temperature coefficient of its electromotive force. Then followed at long intervals the applications to chemical changes which have resulted in the modern science of thermodynamic chemistry with which the names of Helmholtz, Ostwald, Nernst, Van't Hoff, and Gibbs are so closely associated, and upon which the modern industry of chemical

engineering is based.

It is a wonderful development to be able to prophesy that under certain conditions a certain chemical reaction will take place, say, that the nitrogen and oxygen of the air will combine at certain temperatures and pressures in a definite proportion, and that the resultant oxide can be recovered and converted to nitrate and used as fertiliser to replace the imported article at an economic price. The applications of thermodynamic chemistry to explosives enable us to calculate the maximum pressure to be obtained by detonating an explosive, or to calculate the temperatures and pressures throughout the ex-

plosion of cordite in a gun from the chemical constituents of the cordite. This possibility has gone far to raise internal ballistics from an empirical science to a branch of natural philosophy.

The advances which have taken place in the commercial development of chemical processes based upon this important new science of thermo-

chemistry, although already considerable, are only in their infancy, but the men with the experience gained in practical development are very few; and as the experiments are generally very lengthy and expensive, the development of the industry is necessarily slow. The resultant saving to the country, however, will far outweigh the cost.

(To be continued)

#### Indian Agricultural Practice and Research.

DURING the past century of British rule, many attempts have been made to improve Indian agriculture; but wave after wave of effort has broken, with little result, on the firm foundations of the indigenous practice of the country. Until within quite recent years, only in the fundamental matters of irrigation and reduction of famine has any notable advance been made. It is well, then, to look back and try to form a picture of the nature and origin of this indigenous agricultural practice.

When we do so, we are at once struck by the commanding position of the industry in former times, and the enthusiasm with which it was carried on It is generally agreed that the Aryans, an agricultural people, entered the north-western part of India some 4000 years ago; and the view is also held, although more conjecturally, that the Dravidians, also noted agriculturists, had then already intrenched themselves in the south. Of the latter we have little knowledge. But there is detailed evidence in the ancient writings of the delight with which the Aryans regarded cultivation-witness the following extracts from a pastoral hymn on ploughing in the Rig Veda (period 2000 to 1400 B.c.): "Let the god of rains moisten the earth with sweet rains . . . may the crops be sweet to us . . . turn the sod merrily, let the oxen work merrily, let the plough move on merrily, fasten the yoke merrily, apply the goad merrily." Allowing for a certain poetic exaltation, this was a bright beginning; and was undoubtedly followed by a great development of agricultural knowledge and practice in north India. There appears to have been steady progress at any rate until the early part of the Buddhist period (500 B.C. to AD. 500); and western knowledge of Indian agriculture dates from this period, in that it was carefully studied by the Greeks, shortly after Alexander the Great entered the country in 326 B.C.

In ancient India, soils were classified according to colour, taste, productivity, and suitability to particular crops; alkalinity was known and feared; irrigation was widely spread, by dams, tanks, and wells; methods of dry farming were practised; deep ploughing was universal; manuring with animal residues and with oil cakes was practised, and green manuring was known and valued; paddy was sown in nurseries and transplanted into puddled fields; most of the crops now grown were cultivated; the seasons and rains were well understood and allowed for, and agricultural practice seems to have reached a high

level 2 But after the peak was reached, there would appear to have set in a steady decline both in the enthusiasm for agriculture and in the importance attached to it. Most of the details have, however, been handed down by example and oral tradition to the present day. But an Indian writer, after discussing these ancient glories and the progress being made elsewhere, allows himself to describe the Indian cultivator as "an ignorant, custom-bound creature, forced to content himself with his lot." Naturally, the inquiring western student will not altogether agree with this; rather is he struck by the wealth of detail, the rare economy, and the surprising adaptation to environment, and he soon discovers in that environment the main reason why Indian agricultural practice appears to be a mass of contradictions, when first viewed by those trained in western scientific methods.

Putting it briefly, the work of the Indian cultivator is often excellent, considering the limits of his conditions and resources. The first business of any one desiring to improve matters must be a study of this environment. The important benefit conferred by British rule in the development of irrigation has been already referred to; the next great advance was made when, in the early years of the present century, the Government at last recognised the necessity of founding an adequate agricultural department and allocating funds for its permanence. This was done on a generous scale by Lord Curzon, and during the past quarter of a century this department has been expanding and 'digging itself in'; in place of some half-dozen agricultural officers, nearly 200 superior posts have been created, and the number is daily increasing.

Defining research as the detailed study of any subject by a scientifically trained mind, the first difficulty of these officers was to bring their training into alignment with Indian conditions. Any attempt at betterment was of necessity dependent on a knowledge of the local climate, soils, stock, implements, crops, and the resources of the people. Amelioration or alteration was obviously needed, but a series of interlocking factors made this very difficult. Irrigation and dry farming had been practised from ancient times, but are always susceptible of improvement. There is plenty of good soil in India, but much of it has, by continual cropping without due return, reached the verge of 'permanent infertility.' There is a marked deficiency of pasture land, and what there is, is often very inferior; the cattle, therefore, although

<sup>&</sup>lt;sup>2</sup> G. Jogi Raju, Journal Madras Agricultural Students' Union, 8, 2-4, 1920.

numerous, are generally small and weak. As a consequence of this, agricultural implements have to be designed with an eye to the strength of the animals rather than the needs of the soil of humus and nitrogen content are characteristic of cultivated land in the tropics; and cattle manure is easily the most suitable material for remedying this. But most of this manure is, in India, of inferior quality and the bulk is used as fuel; while the rich nitrogenous residue from oil pressing is largely sent out of the country. Pure seed is practically unknown, a field of any crop being usually a mass of unselected varieties. Taking all these things together, the cultivator gets little out of the soil, it is not to be wondered at that he is poor, and anything like the accumulation of agricultural capital is out of the question. Without this capital it is difficult to see the way to any permanent improvement.

The principle of co-operation was early invoked, and some of the first agricultural successes were Agricultural largely dependent on its application co-operation has been an enormous success, and has spread through all the provinces, and it was long ago taken out of the hands of agricultural officers, with a department of its own century efforts have been made to improve the character of the crops grown, largely by introducing strains grown elsewhere; and one of the first lessons learnt in the new department was that this method was unlikely to succeed to any great extent, but that in the mixtures grown many forms were worth selecting and purifying. Work in this direction has been a great success in almost every crop studied, and some seven or eight million acres are now under selected strains of wheat, cotton, jute, and rice, while hybrid canes have been evolved which are rapidly replacing the former inferior kinds.

These two lines of work, co-operation and seed selection, are readily appreciated by the cultivators, and obviously place him in a better financial position. They may thus be regarded as laying the foundation for improvements in other directions. Meantime, a great deal of study was devoted to the pests and diseases of the crops grown, and means for their control worked out. Alterations in agricultural practice, because of its time - honoured nature, are much more difficult. It was soon seen that the importation of the costly and powerful implements of the West would be unsuitable in the circumstances; and as with the crops, a careful study was made of the local village equipment, costing a few shillings, on the chance of increasing its efficiency. Cheap models of improved ploughs, harrows, cultivators, etc., have been evolved; and some 30,000 of these are sold every year. But it must be confessed that a great deal more remains to be done.

There are some 150 million cattle in India, and this very number is one of the chief bars to their improvement in quality. Yet cattle may be said to represent the key factor influencing soil fertility and agricultural practice in India; and far too little research has been devoted to this difficult

problem. An excellent Vetermary Department has existed for years, but it is only quite lately that a proper liaison has been effected between it and the Agricultural Department. One of the most encouraging features of the present-day research is the increasing attention being paid to cattle questions.

Agricultural research in India has, in the past, lagged considerably behind that in Great Britain, for the simple reason that the number of trained men employed was so absurdly inadequate for the work. The total area of the Indian Empire is given as some 1100 million acres. Of this, British India covers a little more than half, the rest being under native rulers; about two-thirds of British India is classed as cultivable. Such figures are impressive; but no one can appreciate the situation as regards research on the agriculture of the country, who has not spent the best years of his life in odd corners endeavouring to better things, continually making long train journeys over territory as yet untouched. This must be constantly borne in mind when reading of the successes of which the Agricultural Department is so justifiably proud. It is probable that not one hundredth part of the country has as yet been

materially affected.

Taking the broad view, we may regard the efforts of the past quarter of a century as so much preparatory spade work; in almost every direction we know a great deal more about the crops and their environment, and can now form an opinion as to where progress may be reasonably expected. Encouraged by incidental successes along the path, the officers of the Agricultural Department are busy applying the most recent advances obtained elsewhere to the solution of their most pressing problems. It is only possible to refer here to one aspect of this development, namely, a fundamental study of the nutrition of man and beast under Indian conditions 3. Thus study embraces the whole of agriculture, as well as veterinary science and certain aspects of medicine. In each case the soil is the basis, with cattle, its mineral constitution and the effect of this on the pasture and vegetable food generally; and with man, the inherent nutritional value of the staple foods of the different nations, and the effect of soil treatment on the nutritive value of the different cereals eaten. The two studies are interlocking. For example, it has been found that the nutritive value of cereals is distinctly higher when the crop has been treated with cattle manure than when artificial manures were used. It is obvious that a great many years of work will be needed before either of these projects can yield its full results. But a promising start has been made. Some of the analyses have shown a surprising difference in the proportions of the more important vitamins in the different cereals; and experimental feeding of animals has thrown suggestive light on the known variation in virility and disease resistance of the different nations inhabiting India--work which will awake interest far beyond the limits of the Indian Empire.

<sup>\* &</sup>quot;Royal Commission on Agriculture in India," vol. 1, part 2, 1927.

#### Obstuary.

Prof W Burnside, F.R S.

BY the death of William Burnside, England has lost a mathematician of rare ability and lasting achievement, and his science can now inscribe another name on her bead-roll of memorable men.

Burnside was born on July 2, 1852, the son of William Burnside, a merchant, of 7 Howley Place, On the paternal side, the ancestry was Scottish: his great-grandfather had been minister of St. Michael's in Dumfries His grandfather went to London and, in the earlier half of the last century, was a partner in the bookselling and publishing firm of Seeley and Burnside

Left an orphan at the age of six, Burnside was educated at Christ's Hospital, where he was a Grecian—a privileged dignity which, by those who know it not, may be pictured from Lamb's essay on that ancient foundation At the school, Burnside attained pre-emmence in mathematics as well

as in grammar

He was elected 1 to an entrance scholarship at St. John's College, Cambridge, being the first man of his year—in the old phrase; and he went into residence in October 1871. Late in his second year (May 1873) he migrated to Pembroke College in the same University. Hegraduated in the Mathematical Tripos of 1875 as second wrangler, being bracketed with Chrystal, who afterwards was professor at Edinburgh; and in the subsequent Smith's Prize examination, Burnside was first, Chrystal second.

A fellowship at Pembroke followed, in his Tripos year. he continued a fellow until 1886. He was at once appointed to lecture in his college: and he lectured also at Emmanuel in 1876, and at King's in 1877. College teaching included selections from the normal course for the Tripos; and Burnside also gave lectures, in one advanced set open to the University, on hydrodynamics subject was coming into vogue again at Cambridge: attention, regularly paid to the previous work of Stokes, was stimulated by the then new work of Greenhill and of Lamb Burnside examined for the Tripos from time to time; and occasionally he did some private coaching.

In one respect, however, Burnside maintained a special undergraduate interest. indeed, a vigorous youthfulness of bearing and appearance was a characteristic through life. At St John's, even as a freshman, he had rowed in the Lady Margaret Eirst Boat which, with the famous Goldie as stroke, went head of the river in 1872 a success not repeated until 1926 Rather light in weight when an undergraduate, always spare and enduring, he kept his rowing form for many years. He rowed in the Pembroke boat so long as he remained in residence after his graduation: a splendid '7,' he had a full share in its steady rise on the river. For some years after he left Cambridge, his reputation as an oar was a tradition in college circles.

<sup>1</sup> For several of the personal records, the writer is indebted to the present Master of St. John's College, Sir Robert F. Scott, who was fourth wrangler in Burnside's year.

After going out of residence, such opportunities for rowing were no longer open. But Burnside had acquired a zest for fishing, and had often gone to Scotland he continued to go there, many a summer, to pursue what grew to be his favourite sport He became an expert fisherman. There were no half-measures with Burnside in any occupation: whatever he undertook, he did thoroughly.

In 1885, at the instance of Mr (afterwards Sir) William Niven, the Director of Naval Instruction himself an old Cambridge man, devoted to natural philosophy, as it was styled—Burnside was appointed professor of mathematics in the Royal Naval College at Greenwich. The rest of his teaching life was spent there. There was a current belief that his old college, Pembroke, had invited him to return to important office. But he remained at Greenwich: his work was to his liking: and the multifarious detail, incident to the duties of a college office or of the presidency of a scientific society, such as the London Mathematical, was almost mexpressibly irksome to him through all

the vears At Greenwich, Burnside's work was concerned with the training of naval officers. It consisted of three ranges There was a jumor section for gunnery and torpedo officers, the chief subject being the principles of ballistics. There was a senior section for engineer officers, the chief subjects being strength of materials, dynamics, and the like. The advanced section-perhaps that in which he exercised the greatest influence on his students—was for the class of naval constructors there, his special mastery of kinetics and of hydrodynamics proved invaluable. He was a fine teacher, stimulating, patient with students though, elsewhere, occasionally his manner might have a note of abruptness he certainly earned their gratitude, as appeared from their spontaneous token of tribute to him when he left in 1919, in an address treasured by him and his family

Burnside had married Alexandrina Urquhart in 1886, soon after going to Greenwich: she survives him, with their family of two sons and three daughters. After his work at the Naval College had ended, they retired to West Wickham in Kent; he enjoyed a leisure spent among his continued researches, his books, and in fishing holidays up in the north. The last year of his life was marked by failing health: and the proximate cause of his death was a recurrence of cerebral hæmorrhage. He died on Aug 21 last: and he is buried in West Wickham churchyard.

Valuable as was his teaching, important as was his influence alike as an examiner in the highest ranges of mathematics and as a strong referee upon contributions submitted to learned societies, it is by his own contributions to the mathematics he loved that Burnside's name will be held in remembrance

Throughout Burnside's residence at Cambridge,

the University had been in the finest flower of her activity in applied mathematics Stokes, Cayley, and Adams were the long-established professors: Maxwell's appointment had been more recent. Physical astronomy, dynamics, light, sound, heat, were the staple subjects of the best students range of electricity and magnetism, except for an infusion of some of the work of Sir William Thomson (afterwards Lord Kelvm), was rather Maxwell's presentation had still to make its place in the Cambridge course, men scarcely even dreaming of the revolution it was to accomplish. Pure mathematics (save for the exceptional appearance of a Clifford or a Glaisher) was left to the unfrequented domain of Cayley. Much of the original thought of her mathematicians in those years found its expression in Tripos problems, a veritable mine of isolated results propounded as Senate House conundrums. Even so, the worship of the mathematical spirit at the shrine of natural philosophy was maintained in a distinctly conservative range. At the beginning of his work, Burnside could scarcely fail to conform to the Cambridge use: indeed, as regards activity in applied mathematics, he largely remained in the older round to the end.

Burnside's earliest lectures were devoted to hydrodynamics, as has been stated already. But the old-fashioned methods for conjugate functions, stream-lines, velocity potential, were being analytically transformed through the introduction of functions of the complex variable For many a day Cambridge had preserved an almost invincible repulsion to the then objectionable  $\sqrt{-1}$ , cumbrous devices being adopted to avoid its occurrence. But some teachers could show that, in twodimensional fluid motion, simplicity and new results were easily attainable by its means; and its formal Cambridge debut was made in Lamb's book. To Burnside's intellect, the new calculus appealed: and, as a matter of record, his first published paper is concerned with elliptic functions, not with hydrodynamics. That paper, modest in size, finished ('elegant' was a favourite epithet) in quality, was published in 1883, and thereafter there flowed a swelling current of papers, embodying the thought of his active brain.

It is not difficult to note various stages in the progress of Burnside's knowledge. From time to time there is an occasional return to his earlier preferences. Thus he had produced hydrodynamical papers in the early 'eighties: he returned to the discussion of waves in 1914. The 'potential,' as used by Green, by Stokes, by Thomson and Tait, was all-important in the Cambridge of the 'seventies: Burnside wrote a paper on that topic in 1894, but the work was now beginning to be affected by function-theory. It soon appeared that he had wandered far from his ancient fold. He had made a profound study of the newer (Weierstrass) elliptic functions, proved in the quality of a few scattered papers. He had delved into differential geometry, a subject which was ignored in Cambridge except for some rarely read selections in Salmon's "Geometry of Three

Dimensions "His study of elliptic functions had compelled him to range - he always ranged to purpose—in the field of the general theory of functions.

Burnside's matured development flashed out me his two papers on automorphic functions, written in 1891 and 1892 The subject belonged to a new section of knowledge, largely maugurated by Henri Pomearé, whose exposition was contained in a succession of memoirs, now classical, in the initial volumes of Acta Mathematica. The underlying idea is simple. Trigonometrical functions are singly periodic: that is, they repeat <sup>2</sup> their analytical form and values, when the argument suffers an increment or a decrement which is any integer multiple of a single quantity. Elliptic functions are doubly periodic: that is, the repetition of form and values occurs, when the argument is similarly changed by integer multiples of two distinct quantities whose ratio must not be real. Jacobi had proved, long ago, that triply periodic uniform functions of a single argument do not exist. But the question remained (though even the existence of such a question had not been obvious, until it was propounded): What is the most general type of periodicity for a function of one variable? And then, naturally, there followed the question: What are the functions with that type of periodicity? Isolated results were known, though of unrealised significance, indicating a general theory, such as Jacobi's elliptic modular functions, and Klem's icosahedral functions. But it was Pomearé who presented the first systematic consideration of the questions.

Into this work of Poincaré, Burnside plunged; in it he revelled; and his fundamental results are to be found in the two papers already mentioned. They have the finished character usual in his work: terse, tree from digression ("No flowers" might have been his motto), moving swiftly in their advance to new results, they reveal the power and the knowledge of a master. In particular, Poincaré had overstated an exclusive result: Burnside detected the overstatement and the cause: and he devised a new class of such functions, simpler than any of the classes due to Poincaré. This investigation led to both simplication and to advance. The full theory has yet to be completed: it awaits the construction of a central function or functions which, while palpably automorphic, shall submit to the customary analytical manipulations, as do the corresponding theta-functions of purely incremental periodicity. When the history of the written, Burnside's name will theory comes to hold an honourable place in the record.

The correction of the very foundation of these artomorphic functions led Burnside further afield, into a region where he explored with ample result. For every such function, the argument is subject to a number of operations, which are independent of one another, are capable of unlimited repetition, and admit all possible combina-

<sup>&</sup>lt;sup>2</sup> The writer remembers one day when Sir William Thomson surprised his hostess at lunch by asking her whether she had noticed that "all the carpets of Christendom are strictly periodic."

ons and repetitions in unrestricted sequence. The aggregate of all the operations, which thus emerge, is termed a group, so that a function is automorphic under a group of transformations But just as the properties of the integers, which occur in the arithmetic of any calculation, merge into the general theory of number without regard to any specific application, so the properties of a group of transformations of an automorphic function are but a part of a more comprehensive calculus. That calculus deals with the composition, the construction, and the resolution, and the essential properties of a group, regarded as an abstract entity subject to mathematical laws, and without any consideration of the regions of its use, whether they are algebraic equations, or analytic functions, or differential equations, or rotations of a solid body, or the divisions of space, to mention only some instances. The first expression of the general notion was due to Galois later, it found a fine exponent in Camille Jordan. By the late 'sixties it had secured mereasing attention in the continental Schools, where soon it divided into two co-ordinate theories, continuous groups and discontinuous groups. The former theory became a grand body of growing knowledge under the inspired researches of Sophus Lie

It was to the theory of discontinuous groups that Burnside devoted himself in the main, though he attained a stage in the discussion of their invariants where some processes of the theory of continuous groups may yet be drafted into service. Paper after paper appeared from him, on a variety of issues, in ordered development, ever adding fresh contributions to the theory, and marked, all of them, by imaginative vision and compelling power. They found their first culmination in his book on the "Theory of Groups," published in 1897, a systematic and continuous exposition of the subject as it then stood, embodying researches of continental workers (always with ample references) as well as his own. His production of papers, on the theory of groups, continued unhastingly and unrestingly; and the range of the second edition of the book, in 1909, was considerably greater than that of the original volume. Even so, his activity in the subject still continued, though with a gradually decreasing production. All this work, original from himself and copious in extent, is a splendid contribution, emanating from one mind, and sufficient to secure the remembrance of his name.

With the coming of the War, there was comparative cessation in Burnside's work. His frame was almost as lithe as ever and apparently as full of easy spring, seeming to belie the passage of years: but his constructive activity in published mathematics slackened, some of it passing silently into the service of his country, in certain naval matters. In those years he undoubtedly continued to produce papers; but the main body of his creative work might be regarded as verging towards its termination.

There stands, however, in the list of Burnside's memoirs, one brief paper (dated 1918) dealing with a topic in probability, among its fellows, it seems

strangely isolated. It now appears that his thought had been settling towards that subject for some time. He has left a draft, which could have been developed into a treatise, on probability though only consisting of the initial chapters, it is complete within its range, it will make a small volume which can proceed to publication exactly as it was written

In recognition of his eminence as a mathematician, not a few academic honours came to Burnside in life He received honorary degrees, Sc D. from Dublin, LL D from Edinburgh He was elected a fellow of the Royal Society in 1893, served on the Council of that body in 1901 and 1902, and was awarded one of the two Royal Medals in 1904 He was a member of the Council of the London Mathematical Society for the long continuous period from 1899 to 1917, where he was a tower of strength in advice, he was awarded the De Morgan medal in 1899: and in 1906-7-8 he served as president (he had accepted the office with grave and characteristic reluctance) honour which he esteemed perhaps most of all, was conferred on him in 1900 he was then elected an honorary fellow of his old college, Pembroke, of which he had become the senior among the honorary fellows at the time of his death Yet even in the few remarks of thanks which he made at the College dinner welcoming, by courteous custom, the newly elected honorary members of the foundation, he urged that the happy and successful pursuit of research was its own reward; and the sincerity of his plea was appreciated not least by those who had done their part in recognition of his labours.

Significant and merited as were the academic honours conferred upon him in life, to William Burnside, as to men of like mark in their generations, the most enduring monument is the work that his genius contributed to the progress of his science

A. R. F.

#### MR. C. M. WOODFORD, CMG.

WE regret to record the death at Steyning, Sussex, on Oct 4, of Mr Charles Morris Woodford, for eighteen years administrator of the Solomon Islands. Mr. Woodford was born at Gravesend in 1852, and educated at Tonbridge School. On leaving in 1871, he went to the western Pacific as a naturalist and collector for the Rothschild Museum at Tring. For ten years he explored Melanesia, visiting the Solomons three times between 1886 and 1888. These islands then had few European inhabitants. Most of them were British, and they lived in constant danger from the native inhabitants, whose habits then fully accorded with the popular idea of a savage, as they were bloodthirsty cannibals, and assiduous in headhunting Woodford, however, succeeded in acquiring a considerable knowledge of their habits and characteristics, which he was afterwards to turn to good use

In 1895, Mr Woodford became acting Consul and Deputy Commissioner in Samoa, and in the following year he was appointed first resident

Commissioner in the Solomon Islands by Sir J. B Thurston, Governor of Fiji—In 1900 he proclaimed the Solomons a British Protectorate and hoisted the flag. In 1912 he was made a C.M (), and in 1915 he retired. During his term of office he succeeded in impressing his strong personality on the natives. He induced them to abandon their head-hunting and cannibalistic habits, and put down the murder of white traders and missionaries—Under his influence the natives provided the labour for the extensive coconut plantations established in the comparatively settled conditions which he set up, even though sporadic outrages, such as that reported within a day or two of his death, still occurred.

Mr. Woodford's profound knowledge of the natives was mainly turned to profit in the practical affairs of administration; but such contributions as he made to anthropological literature were

marked by their powers of close observation and careful and accurate record

WE regret to announce the following deaths:

Prof. Max von Gruber, president of the Bavarian Academy of Sciences, known for his work on social hygiene, on Sept. 17, aged seventy-four years.

Lord Iveagh, K.P., G.C.V.O., F.R.S., Chancellor of the University of Dublin, who, among numerous public benefactions, gave £250,000 to the Lister Institute of Preventive Medicine for the endowment of bacterological research, and was elected in 1906 to the Royal Society under Rule 12, which provides for the election by the Council of "persons who, in their opinion, . . . have rendered conspicuous service to the cause of science," on Oct. 7, aged seventy-nine years.

Prof. Emil Zettnow, director of the department of photomicrography at the Robert Koch Institute in Berlin, on Sept. 7, aged eighty-five years.

#### News and Views.

In an article in last week's issue of Nature, the main characteristics of several types of metallurgical photomicrographic apparatus at present on the market were discussed, and it was suggested that British manufacturers must pay more attention to details of mechanical construction and design of this type of apparatus if they are to compete successfully with Continental manufacturers. That such competition is making itself felt is shown by the fact that twentytwo institutions and firms in Great Britain, and also sixteen in the United States, have recently installed Reichert metallurgical photomicrographic equipments of the type referred to in the article. From the point of view of British industry, it is unsatisfactory that so many British purchasers should have to place their orders with a foreign firm for an apparatus of such importance in industry and in scientific investigations. In 1920 the Faraday Society, under the presidency of Sir Robert Hadfield, in conjunction with the Royal Microscopical Society, the Optical Society, and the Photomicrographic Society, held a symposium on "The Microscope: Its Design, Construction, and Applications." A valuable discussion took place, in which microscope users stated their requirements and manufacturers presented their proposals to meet these requirements. The meetings aroused a considerable amount of enthusiasm on the part of manufacturers and resulted in the production of several types of microscopes of such a quality and m such quantity as to meet fully the requirements and the demands of the users. It would seem, however, that in regard to photomicrographic apparatus for metallurgy, the manufacturers have not kept pace with the demands of the metallurgists.

MESSRS. Hadfield's, Ltd, desire to purchase an up-to-date metallurgical photomicrographic outfit. In order to avoid the necessity of placing the order abroad, Sir Robert Hadfield informs us that he or his firm is prepared to pay to any manufacturer who will supply a British-made equipment similar to the Reichert large photomicrographic apparatus, or one which fulfils the requirements of the metallurgist at

least as fully as does the Reichert, a premium of £50 in addition to the price at which the Reichert equipment is now obtainable. For photomicrographic work, the adjustment of the intensity of illumination requires a system of auxiliary lenses and light filters. These must be held in definite relation to the microscope itself, as must also the camera. For metallurgical purposes, the camera must be capable of being used also for macrophotographic work. This involves the production of an elaborate and delicate piece of apparatus, but it is certainly not beyond the resources of British microscope manufacturers. They have the advantage of a Scientific Instrument Research Association which is rendering valuable service to the industry. There is also a chair of instrument design at the Imperial College of Science and Technology, where the scientific principles of design are taught. The technical knowledge and skill of the British optician and mechanician are of a high standard, as is evidenced by several other types of instrument at present on the market. Since attention has now been directed to mechanical details in British photomicrographic apparatus in which improvement might be effected, it may be confidently anticipated that Sir Robert Hadfield's offer will meet with a ready response. Its acceptance and the successful completion of the order would undoubtedly result in increased sales of Britishmade apparatus of this type.

On Oct. 10, Prof. W. C. Melntosh, of St. Andrews, the Nestor of marine biology in Great Britain, entered upon his ninetieth year. Prof. E. E. Prince, Dominion Commissioner of Fisheries for Canada, who is visiting England, has sent us an appreciation of Prof. McIntosh's work, from which we are glad to print the following extracts. Born in St. Andrews in 1838, Prof. McIntosh passed through his arts course in the University of St. Andrews and his medical course at the University of Edinburgh. On graduating M.D. he was awarded the University gold medal, for a thesis on some peculiar features in the shore crab. Though burdened with heavy official duties when appointed to the Perth Mental Hospital in the late

fifties, he decided to devote himself as a scientific investigator to the marine annelids. The great "Monograph of British Annelids," the last of the long succession of superbly illustrated parts of which was issued only in 1923, is a monumental work. It will ensure lasting fame for its venerable author, and rank him as one of the very great zoologists of our time. The Nemerteans, so rich in the rock-pools of St. Andrews, first claimed his attention. At Perth, in sea-water tanks far from the sea, he skilfully carried on his studies on the living forms, and with marvellous artistic skill portrayed the gorgeously tinted creatures In 1884 was published the famous Report to the Royal Commission on Trawling, embodying work done on many cruises and including the discovery that the sole and other fish produced floating eggs. Prof. McIntosh is the pioneer in Great Britam of sea-fishery investigations, and it is a matter for congratulation that he continues active in the pursuit of zoological science and is as zealous as in his earlier years.

AT the opening of the thirty-sixth session of the School of Pharmacy of the Pharmaceutical Society on Oct. 5, the Hanbury Memorial Medal for "high excellence in the prosecution or promotion of original research in the chemistry and natural history of drugs" was presented to Dr T. A. Henry, Director of the Wellcome Chemical Research Laboratories Dr. Henry, in an address on receiving the medal, stressed the importance of maintaining a close relationship between pharmacology and organic chemistry. Although the position of Great Britain as a producer of new synthetic drugs has improved since 1914, yet it is only too notorious that many of the additions to the physician's armamentarium come from abroad, especially in the case of drugs used in the treatment of tropical diseases. This is not a creditable state of things for a great Empire: in part it is no doubt due to the fact that, as a nation, we are more interested in the preventive than in the curative side of medicine: on the other hand, the tack of facilities for pharmacological testing has also militated against research. For this reason, Dr. Henry welcomed the opening of a pharmacological laboratory by the Society. New compounds are always being synthesised, the pharmacological properties of which ought to be tested, especially when it is remembered that it is only one out of many examined, which will finally find its place in practical therapeuties. For scientific research, therefore, adequate facilities for pharmacological testing are essential, in order to direct the chemical work as it develops and to assist it as required. Moreover, quite apart from the production of new synthetic drugs, pharmacological assay of therapeutic substances of unknown chemical constitution, such as insulin, require the assistance of trained pharmacologists. In both these directions Dr. Henry considers that the new laboratory will prove itself of great value.

 $T_{\rm H\,E}$  presentation of the Hanbury gold medal of the Pharmaceutical Society of Great Britain to Dr. T. A. Henry, affords an opportunity for recalling

the work of the man whose name is commemorated in the name of the medal. Daniel Hanbury was the son of Daniel Bell Hanbury, a president of the Pharmaceutical Society and one of the founders of the historic business which still bears his name. The son, born in 1825, early impressed his contemporaries by the beauty of his handwriting and his skill at watercolour painting, talents which he later developed in his characteristically painstaking and detailed descriptive work. His writings included a series of papers on Chinese materia medica; numerous contributions to the Transactions of the Linnean Society, and the "Pharmacographia" published in conjunction with Prof. Fluckiger, of Strasbourg, which was completed in 1874. Shortly after his death in 1875, a fund was raised for the purpose of giving from time to time a gold medal to perpetuate his memory The medal is awarded for high excellence in the prosecution or promotion of original research in the chemistry and natural history of drugs, the award being made by a committee composed of the presidents for the time being of the Chemical, Linnean, and Pharmaceutical Societies, the chairman of the British Pharmaceutical Conference, and one pharmaceutical chemist. Twenty-one awards have been made since 1881, when the first medal was presented to Hanbury's co-worker, Fluckiger. Englishmen naturally head the list of recipients, but Germany, France, Switzerland, Russia, and the United States are also represented The last award was made in 1922 to Prof. Emile Perrot, of the University of Paris, and in the list of earlier recipients occur the names of Dragendorft. De Vrij, Ladenburg, Tschirch, and F. B. Power. Dr. Henry's work has been mainly upon problems connected with the chemistry rather than the natural history of drugs, but his reputation in that field of research and the wide range of subjects covered in his published papers both in Great Britain and abroad, indicates the appropriateness of the award of the medal to him this year.

CONTROVERSY still rages over Glozel, and Dr. Morlet continues to champion the genuine character and the high antiquity of the alleged implements and inscriptions on the clay tablets found there in the Mercure de France and numerous separately issued pamphlets. In the meantime, according to a dispatch from Paris which appeared in the Times of Oct. 6, the site at Glozel has been declared a national historical monument, and M. Heriot, acting in his capacity of Minister of Education, has informed Dr. Morlet in a letter that it has been placed under the control of M. Peyrony, the eminent archæologist and member of the Historical Commission. M. Peyrony will be assisted by M. Champion, head of the technical department of the National Museum. All future discoveries will theretore be officially scheduled. M. Peyrony's profound and intimate acquaintance with the palæolithic sites of France and their antiquities should provide an acid test of the genuineness of any future find as Glozel. At the same time, it must be admitted that the camp of the pro-Glozelists is by no means negligible, including as it does Dr. S. Reinach, Dr. Van Gennep, M. de Laborde, Senor Leite de Vasconcellos, and Prof.

Mendes-Correa. They are, however, by no means While Dr Morlet regards the united in their views site as a link between paleolithic and neolithic, others, accepting the antiquity of the specimens, assign them to the various periods from the Magdalenian to the neolithic, but are hard put to it to explain the simultaneous occurrence of remains of all these periods on one site. Some, again, assign the site to so late a period as the Gallo-Roman. Against these views must be set the weighty authority of the Abbé Breuil and others, to which we have referred from time to time in these columns. Their great experience in handling the relics of early man renders their verdict of forgery one which it is difficult not to accept.

A Science Exhibition held at Hastings in the White Rock Pavilion on Oct. 5-8 shows what it is possible to do in popularising science among the inhabitants of a residential town. The promoters were local scientific and professional men, with the Mayor as chairman and the master of the Grammar School as honorary secretary and treasurer; in fact, it was quite a co-operative effort. The ann was to attract the ordinary man as well as the serious student by exhibits showing the advances in modern scientific knowledge, but the merely amusing was excluded This involved much thought in planning, but the actual getting together of models and apparatus did not present serious difficulty for, as the catalogue shows, they were obtained on loan from public institutions, firms, and private individuals. exhibits were divided into sections: engineering, electrical; radio and signalling; chemical and physical; and applications of science to the arts and to music. Since science objects, unlike art exhibits, cannot be appreciated merely through the eye, but call for exposition, care was taken to have stewards at hand to give explanations, while short talks and demonstrations followed one another from 3 P.M. until 9 P.M. each day; there was also a lantern lecture each day by a well-known man. The exhibition, which was well advertised by a specially designed poster and folder, was a great success, and may well serve to induce other local authorities to arrange exhibitions of a like character.

THE courses of lectures at the Royal Institution during November and December will commence on Tuesday, Nov. 1, at 5.15 P.M., with the annual course of three Tyndall Lectures, which will be delivered by Sir John Herbert Parsons on the subject of light and sight. These will be followed on Nov. 22 by four lectures by Sir William Bragg on a year's work in X-ray crystal analysis. On Thursday afternoons, beginning on Nov. 3, there will be two lectures by Mr. H. Clifford Smith on the furniture and equipment of the medieval house; three by Dr. R. E. Mortimer Wheeler on London before the Norman conquest; and two by Mr. James Kewley on petroleum natural gases and their derivatives. The Saturday lectures will be given at three o'clock, starting on Nov. 5, when Mr. Emile Cammaerts will give two lectures on the main features of modern English literature, to be followed by three musically illustrated lectures by Mr. Gustav Holst on Samuel Wesley and Robert Poarsall, and two lectures by Mr. F. J. M. Stratton on recent developments in astrophysics. The 102nd course of Christmas Lectures for Juveniles will be delivered by Prof. E. N. da C. Andrade on "Engines," commencing on Thursday, Dec. 29, at three o'clock. The subjects of the lectures will be (1) The rules which all engines must obey; (2) learning about steam; (3) engines which work to and fro; (4) engines which work round and round; (5) putting the furnace in the cylinder; (6) heat engines which produce cold.

Referring to the letter by Messrs. Rosenheim and Webster in Nature of Sept. 24, p. 440, Mr. C. A Hill, of the British Drug Houses, Ltd., writes informing us that, immediately after the publication of Rosenheim and Webster's work on ergosterol in February last, his firm placed irradiated ergosterol at the disposal of medical men. Since then, the British Drug Houses, Ltd., has achieved the largescale production of ergosterol and of the irradiated product, so that the latter is now available commercially. It is already on the market in a popular form for the public use; it is available for manufacturers of margarine to bring their product up to the standard of summer butter, which they can do at a fractional merease in cost, and chocolate manufacturers are already experimenting with it.

On Sept. 10 the second Pan-Union Archaeological Conference was opened at Sevastopol. It lasted until Sept. 15 and was followed by an excursion, in the course of which the delegates were conducted to the principal archaeological sites in the Crimea by Prof. C. E. Grinevich. The Congress coincided with the hundredth anniversary of archaeological excavation in the Chersonese, for, as stated in a historical survey by Prof. Grinevich, it was in 1827 that Admiral A. S. Greig, who was of Scottish descent, ordered Lieutenant Crusoe to begin exeavations in the Tauric Chersonese. Work was sarried on intermittently until 1885, when systematic excavation of this Dorian colony was begun and pursued continuously until 1915. It was renewed after the War in 1925, and at the same time the rich collections were reclassified and housed in the former monastery buildings. Representatives of the Academy of Sciences and the principal archeological museums and institutions of the Soviet Republics were present at the Congress, and a number of communications, some twenty in all, were presented in two sections, one covering Chersonese archæology, the other general archæology. Among these, G. A. Bonch - Osmolovsky described excavations in Kukrek and the Siuren Caves of sites belonging to the Stone and Bronze Ages, from which had been obtained bones of mammoth, rhinoceros, cave bear, and the skeleton of a dog. Considerable discussion was aroused by Prof. Grinevich's communication on the oldest defence wall of Chersonese, delivered from the wall itself, which seriously modified pre-existing ideas of the topography of the town.

TEE Imperial Department of Agriculture in India has commenced the issue of a new quarterly agri-

adtural journel, of which Part 2 (July 1927) has been received. The Journal of the Central Bureau for Animal Husbandry and Dairying in India, as it is named, will deal with cattle breeding, dairying, cultivation and storage of fodder crops, animal nutrition, and other aspects of animal husbandry, and the present number contains five articles on various aspects of Indian cattle and dairying, one on poultry feeding, and part 2 of a veterinary entoinology for India. The journal is illustrated and the subscription price is Rs 2-8 per annum.

The annual Report for 1926 of the International Health Board, Rockefeller Foundation, has been issued. Public health work has been assisted in eighty-eight States and countries. Governments have been assisted in surveys relating to yellow fever, hookworm, malaria, and other diseases, in campaigns for the control of yellow fever and hookworm disease, in field studies in malaria and hookworm disease and in demonstrations of malaria control; in county and district health work; and in the development of public health services, such as epidemiology and vital statistics, samtary engineering, public - health laboratories, and nursing. Contributions have been made to schools of hygiene for education, including the London School of Hygiene and Tropical Medicine. Fellowships in public health were provided for 253 men and women of thirty-one countries. The Board also co-operated with the Health Section of the League of Nations. The expenditure for the year amounted to 3,260,524 dollars The report gives a summary of the Board's activities and contains many maps, charts, and diagrams, and illustrations.

An air survey of the western part of Northern Rhodesia is to be undertaken by the Government of that country. The Times reports that the area to be surveyed covers the valley of the Upper Zambezi for about four hundred miles above Livingstone and includes the two tributary rivers, the Lungwebungu and the Kabompo. This region is almost entirely unmapped and undeveloped, but is believed to have considerable mineral wealth. Major Cochran-Patrick will be in charge of the survey and the aeroplane will be supplied by the Aircraft Operating Company. The machine to be used is at present working on survey near N'Changa, and will be flown to Livingstone to be fitted with floats. The aeroplane will fly at a height of 10,000 feet along the course of the river, and a series of vertical overlapping photographs will be taken. Larger scale photographs will be taken of rapids. Ground control is being provided by the company's surveyors, who will fix points by observation, using radio time signals.

ONE of the whalers at work in the waters around Graham Land is reported in the Geographical Journal for September to have made a voyage through Bransfield Strait and to have reached Peter I. Island, which has not been visited since its discovery by Bellingshausen in 1821. The whaler, Odd I., circumnavigated the island seeking in vain for a safe harbour; heavy weather prevented a landing. The island is

8 miles long and 5 miles broad Most of it is covered by snow or ice, and only on the western side is there much bare rock. It rises to about four thousand teet, and the absence of an ice foot on the coast suggests, but does not prove, that it is clear of solid pack throughout the year. The same whaler reports in lat. 60° 30′ S., long. 52° W., that is, west of the South Orkneys, an iceberg which was estimated to be about a hundred miles in length and 100 to 130 feet above the water line. Other enormous tabular bergs were sighted in the vicinity. It seems not improbable that these bergs represent the broken Stancomb Wills ice tongue of Coats Land or fragments The currents of the Wilhelm Barrier farther south of the Weddell Sea would carry ice from that direction to the north-western corner of the sea.

THE experiments being made with short radio waves all over the world are giving most astonishing results. In the October number of Experimental Wireless, the Radio Research Board refers to results obtained by E. Quack, published in two German technical papers. Oscillographic records have been obtained at Geltow, near Berlin, of signals sent from Rio de Janeiro. Each signal is accompanied by an 'echo' signal, caused most probably by waves which have travelled round the earth in the opposite direction to the direct signal. This is most curious, because the beam transmitter is not only directional but also works with a reflector. Further experiments carried out recently show that several signals are received at definite equal intervals after the first signal. As the interval of time between the first direct signal and these additional signals is always a multiple of 0·137 of a second, it looks as if the waves, after eausing the first signal, travelled completely round the world several times, recording signals as they passed the receiver. For waves lying between 14 and 34 metres, double signals have been observed. It has also been noticed that double signals occur most commonly when the great circle on which the receiver and transmitter lie is in twilight. On the other hand, the 'echo' signals caused by waves travelling round the world in the opposite direction to the direct signal are often noticed in the day-time. The attenuation of the signals after encircling the earth several times is not great, and it is concluded that many more encirclings occur before the waves subside. In practical work, methods have to be devised to eliminate the disturbances caused by these multiple signals, but their systematic study should be a great help in elucidating the phenomena of short wave propagation.

DR. W. G. SAVAGE, Medical Officer of Health, Somerset, will deliver the second annual Malcolm Morris Memorial Lecture under the auspices of the Chadwick Trust on Oct. 17. taking as his subject "Food Poisoning." The lecture will be given in the Hastings Hall of the British Medical Association.

The Council of The Institution of Civil Engineers has made the following awards: The Howard Quinquennial Prize to Prof. W. E. Dalby, in recognition of his researches on the strength and structure of

iron and steel; The Indian Premium to Mr. A. W. Stonebridge. For selected engineering papers published during session 1926–27: A Telford Gold Medal to Sir E. Owen Williams (London), Telford Premiums to Dr. E. H. Salmon (London), Mr. R. S. Cole (India), Dr. H. Mawson (Liverpool), and Mr. A. H. Douglas (London), and a Crampton Prize to Mr. D. M'Lellan (Glasgow).

APPLICATIONS are invited for the following appointments, on or before the dates mentioned. Three examiners (men or women) in the Industrial and Commercial Property Registration Office of the Mmistry of Industry and Commerce, Dublin, for the examination of applications for patents for mechanical engineering, electrical engineering, and chemical inventions—The Secretary, Civil Service Commission, 33 St. Stephen's Green, Dublin (Oct. 19). An assistant lecturer in agriculture, book-keeping, and farm costs at the South-Eastern Agricultural College, Wye - The Secretary, South-Eastern Agricultural College, Wye, Kent (Oct. 21). A fishing mate and a chief engineer in the fishery research vessel of the Ministry of Agriculture and Fisheries at Lowestoft-The Secretary. Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Oct. 22). An assistant naturalist in the Laboratory of the Marine Biological Association of the

United Kingdom The Director, Marine Biological Laboratory, Plymouth (Oct. 23). A scientific office? under the Air Ministry, primarily for duty at the Royal Aircraft Establishment for design and research work in connexion with high speed supercharged internal combustion engines and with special reference to research on blowers—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants, quoting A 220 (Oct. 24) A research assistant for blast furnace reactions research at the Imperial College of Science and Technology -- The National Federation of Iron and Steel Manufacturers, Caxton House (East), Tothill Street, S.W.1 (Oct. 25) demonstrator in morganic chemistry in the University of Leeds - The Registrar, The University, Leeds (Oct. 26). An Inspector under the Alkalı, etc., Works Regulation Act, 1906 The Director of Establishments, Ministry of Health, Whitehall, S.W I (Oct. 29). An assistant lecturer in economics and political science in the University College of South Wales and Monmouthshire--The Registrar, University College, Cardiff (Oct. 29). A lecturer in hygiene in the department of education of the University of Bristol -The Registrar, The University, Bristol (Nov. 12). An assistant research physicist at the Gramophone Company, Ltd.—The Gramophone Company, Ltd., Hayes, Middlesex (quoting Z14).

#### Our Astronomical Column.

DETECTION OF SCHAUMASSE'S COMET. This periodic comet, which was discovered by M. Schaumasse at Nice in 1911, and seen again on its return in 1919, has now been detected by Prof. G. van Biesbroeck at the Yerkes Observatory on Oct. 4d 10h 22·8m U.T., in R.A. 11h 6m 2·5s, N. Deel. 12° 57′ 59″, magnitude 12. The position is in excellent accord with that derived from the elements given by Dr. G. Merton in Mon. Not. Roy. Ast. Soc. for May last, the time of perihelion passage being Oct. 1.43 as compared with the predicted value Oct. 1.54. The comet is very badly placed, being low in the east at dawn, but it will be even worse placed at its next return in 1935, so it is fortunate that it has been found, as if missed for several returns it would have been difficult to find it again. This is the second comet this year for which Dr. Merton has predicted the perihelion passage within a tenth of a day; the other was comet Grigg-Skjellerup. In the present case, the forecast by the Nice astronomers was Nov. 19, seven weeks too late, so that the comet would not have been found if this had not been corrected.

THE TOTAL SOLAR ECLIPSE OF JUNE 29.—Forschungen und Fortschritte for Sept. 20 contains an article by Dr. H. Kienle, of the Observatory of the University of Gottingen, describing the expedition from that observatory to Gallivare, Swedish Lapland, to observe the eclipse. The height of the sun was 27° and the duration of totality 42 seconds, these being practically the greatest values obtainable at any land station; in consequence it was selected by ten different expeditions from Germany, Holland, Sweden, Esthoma, Russia.

The programme of the Gottingen party included flash spectra with a slit spectroscope, measures of radiation with a photo-electric cell, and photometry of the corona. The radiation measures began an hour before first contact, and continued until an hour after last contact. The sky was clear except for two bands of clouds that were near the sun during totality. These interfered with the observation of the second flash and with the later corona photographs, but the rest of the programme was carried out successfully. Totality is described as "Eine besonders helle und schöne Erscheinung, die nur leider viel zu kurz andauerte"; but details of heresults are reserved for a future paper.

OBSERVATIONS OF THE VARIABLE STAR Z HERCUIA -Bull. Internat. de l'Acad. Polonaise des Science, contains a series of observations of this star made by M. Jean Gadomski of the Observatory of Cracow at the mountain station on Mt. Lysina (3000 feet The period of light-variation falls short of high). 4 days by only ten minutes; in consequence it is difficult to follow all the phases of the star at a single station. However, by making 141 observations on 38 nights in 1923, the author succeeded in determining the whole of the variable part of the light curve. The eclipses last altogether 9.6 hours, just a tenth of the period: the curve seems to be quite symmetrical about minimum, implying that the orbit is appreciably circular. The light is stationary for 2.2 hours at minimum, which shows that the eclipse is total or annular for that period; the rise and fall are rapid for 2.4 hours before and after minimum, and slow for the rest of the eclipse. The magnitude is 7.19 at maximum, 8.01 at minimum.

The study of variable stars is one of the special lines of work undertaken by Poland; also the computation and publication of ephemerides of many of them. Observations of eclipsing variables, when combined with spectroscopic observations of radial velocities, give valuable information on the diameters and surface brightness of the stars.

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#### Research Items.

Scottish Brochs.—In Antiquity for September, Mr. Alexander O. Curle discusses the origin and structure of the broch—the characteristic defensive structure of the north and west of Scotland, consisting of a circular tower surrounding an open court, built of dry masonry without mortar or other binding material, and of which the height originally in some cases must have been as much as 60 feet. The walls at the base are usually 15 feet thick and contain series of superimposed galleries. A puzzling feature, a ledge projecting about 12 inches from the interior of the wall, is now explained in the light of excavations at Dun Troddan, as the resting place for beams extending to posts circling the interior and forming the roof of a closed coloniade around a central hearth open to the sky. The brochs have no relation to the Nurhagi of Sardinia, which differ from them ossentially in structure and purpose. Their closest analogies are to be found in the galleried duns or promontory forts and the so-called 'semi-brochs' of the west of Scotland. The distribution of the broch points to its origin in the north and west of Scotland, those found outside this area being due to an extension of tribal influence from the north. In date they are to be regarded as not earlier than the Iron Age, while the occurrence of Samian ware. Roman coins, and other objects, indicates that they were occupied at the time of the Roman invasion and in the second century A.D., though probably they date back some hundreds of years before that time. They probably were occupied for some time later, but from the absence of wheel-made pottery and Viking relies, it cannot be asserted that they survived to the eighth

The Birds of Ancient Egypt.—In the Nineteenth Century for October, Prof. R. E. Moreau publishes a study of the birds depicted on the monuments of ancient Egypt. Bird forms appear with great frequency in reliefs and paintings on tomb walls. Yet a closer examination of this great mass of material reveals that there is much repetition and continuous copying. The earliest work is the best. Three flerent kinds of geese at Medum were painted with the cat faithfulness. Nothing equals them in later Egyptian history or in the western world until fifty

years ago. The uncoloured reliefs of Sakkara of the fifth dynasty come next to the paintings at Medum. The earliest bird relic is an exquisite ivory figure of a nightjar of predynastic age, before 3400 B.C. at the latest This bird does not appear in Egyptian art again. In the marsh scenes of the Tomb of Ti a large number of birds are shown, ibises, gallinules, herons, spoonbills, cormorants, and spur-wing plovers. Genet cats crawl through the papyrus raiding the nests. An exquisite scene of a kingfisher fluttering round a cat's head while its mate hurtles down in defence of the half-fledged young was copied repeatedly in all its details in later times. In the paintings a number of traps are set for the ornithologists in the restrictions imposed upon the colourist by his palette. Thus gray is represented by a strong bluish green. Mummied birds make only a late appearance in the twentieth dynasty. Nearly thirty species of raptorial birds have been identified at Kom Ombo. Apparently the practice was intended in honour of the hawk-headed god Thoth. Mummied ibsses come from Sakkara. They honour Isis and apparently are connected with the idea of fruitfulness. Some birds identifiable have now disappeared from Egypt—the red-breasted goose, the chanting goshawk, and the sacred ibis. In numbers there must be great impoverishment.

Captive Crickets—Under the title of "Insect Musicians and Cricket Champions of China," Mi. Berthold Laufer, of the Field Museum of Natural History, Chicago, has recently issued an interesting brochure on the ancient Chinese custom of keeping crickets in captivity. It appears that in A.D. 618–906 they began to keep them in cages in order to enjoy their song, while in A.D. 960–1298 they developed the sport of cricket fights. The cult of cricket-keeping, and the vessels and instruments employed, are admirably discussed and figured in this pamphlet, which should be read by any one interested in the subject

POPULATION DENSITY AND DURATION OF LIFE IN Drosophila —The influence of the density of population on the duration of life of Drosophila melanogaster has been investigated experimentally and the results analysed statistically by Prof. Raymond Pearl and his collaborators (R. Pearl, J. R. Milner, and Sylvia L. Parker, American Naturalist, 61, p. 289; 1927). The general method of experiment was to introduce the young flies in varying numbers—from 2 to 200 into one-ounce bottles containing 8 c c. of a bananaagar, or other standard food inixture. The total number of flies was 13,000, distributed in 530 bottles, and equal numbers of males and females. The longest duration of life was found to be when the flies numbered 35-55 per bottle, and with larger numbers the mean duration of life declines steadily with advancing density. A wholly unexpected result was that minimal population densities are not optimal for duration of life. The deleterious effect of crowding is most pronounced during the first few days of life, and is exerted even upon those flies that do not immediately die as a result of it.

SILK PRODUCTION IN THE SILKWORM.-In the Journal of the College of Agriculture of the Imperial University, Tokyo (vol. 9, 1927, pp. 119-138), Mr. Jiro Machida discusses the secretion of the silk-forming substance in the silkworm. It is well known that two chief silk substances are produced, fibroin and sericin, but opinions differ with regard to their origin. By some it is maintained that the fibroin is first secreted and a part of it becomes oxidised later into sericin. By others the two substances are considered to be distinct from the beginning. Mr. Machida's methods of study were primarily histological and, after suitable fixation, the silk glands were dissected from the body of the caterpillar and cut into sections. By means of a mixture of equal volumes of 1 per cent. aqueous solution of acid fuchsin, 2 per cent aqueous solution of methyl green, and an aqueous saturated solution of pieric acid, good staming was obtained, the fibroin appearing blue and the sericin purple. From an examination of material treated in this manner, he concludes that fibroin and seriem are secreted as different substances in different parts of the glands, sericin being produced along the whole length of the middle division and the fibroin at the posterior division of each gland.

MITOCHONDRIA AND CELL INJURY.—The September issue of the Journal of the Royal Microscopical Society contains a pictographic review by G. M. Findlay of the changes which occur in mitochondria as the result of injury to the cell—Whether these changes are due to direct action on the mitochondria or to changes produced in the cytoplasm is unknown. The most common qualitative change is in shape—a transformation of rods into granules which occurs in many pathological conditions. It is noted that though qualitative changes can readily be produced by patho-

logical conditions in gland-cells, there is no evidence of corresponding change in the cells of the central nervous system in such conditions as fatigue, poliomyelitis, and botulism. The quantitative variations which occur under different physiological conditions make extremely difficult any estimate of quantitative change under pathological conditions Changes of position of mitochondria within the cell are by no means rare; eq. in tissue culture individual mitochondria pass from the nuclear region to the periphery of the cell and back again, but the reasons for these movements are unknown. Observations on mitochondria in pathological conditions throw little or no light on their function. As first suggested by Regaud (1909), the surfaces of the mitochondria may be the loci of synthesis in the cell Joyet-Lavergne (1927) has found that mitochondria are coloured by sodium nitroprusside, and it is therefore possible that they represent the cell areas in which the auto-oxidisable substance glutathione is concentrated. The review is illustrated by 24 plates, and a list of references is appended.

Crustacea of the North Sea and Baltic.—Recent additions to the ('rustacea in "Die Therwelt der Nord- und Ostsee" (Leipzig . Akademische Verlagsgesellschaft, 1927, Lieferung 8) are the non-parasitic copepods (Copepoda non parasitica, by O. Pesta, Teil X. e 1), the Crippedes (Cirripedia, by P. Krüger, Teil X. d), and the Leptostracea, by Johannes Thiele, in Lieferung 7 (Teil X. g 1). With such a large group as the free-living copepods, much space must necessarily be occupied by the systematic survey, which is here particularly useful, giving keys to the genera of the three groups—Calanoidea, Cyclopoida, and Harpacticoida. The harpacticids being so much less known than the other two, the notes on these are specially welcome. In the biological part the author gives a summary of his own previous work on the relations between the build of the copepod and the method of movement in marme forms, in which he designates three types: floaters, swimmers, and creepers, calanoids being typical of the first, harpacticids of the last, and amongst the swimmers are members of all the groups.

PRODUCTION OF PLANKTON.—Observations were made by Prof. H. H. Gran on the spring production of diatoms in Norwegian coastal waters off Bergen in 1922 (Report on Norwegian Marine and Fishery Investigations, vol. 3, No. 8, 1927). The outburst was of its usual short duration, reaching a maximum on Mar. 23, after which date there was a rapid decrease. The predominant species were Thalassiosira Nordenskioldii and Skeletonema costatum, which each attained a density of more than 200,000 cells per litre. It is suggested that this plankton and the requisite supply of nutrient salts came in the Baltic stream which issues from the Skager Rack, where a similar plankton occurs about a month earlier. Working on Mohn's figures for the average velocity of the Baltic stream, 0.4 sea mile per hour, it would take just a month for water from the Skager Rack coast of Sweden to reach Bergen. Collections taken in the Hardanger Fjord showed a different diatom population, with Leptocylindrus minimus the most abundant form (up to 2½ millions per litre). On the basis of the increase of oxygen, shown in the coastal waters to run parallel with the diatom maximum, the production down to a depth of 10 metres was estimated as being 1.4 gm. glucose per cubic metre for the minimum value for three weeks. It must be realised that during this period much oxygen was probably being lost to the atmosphere from the supersaturated surface waters, and results from culture experiments gave consider-

ably higher values. By this means the productives estimated as 5.2 gm, glucose per cubic metro 20 days, or an average of 0.26 gm, glucose per 24 houper cubic metro.

INDIAN FOREST PLANTS. - In a recent number of the Indian Forest Records (vol. 13, pt. i., 1927) Mr. R. N. Parker, Forest Botanist at the Research Institute at Dehra Dun, commences a series of "Illustrations of Indian Forest Plants." The author gives as his reason for undertaking this work that much useful information not generally known is available in the form of specimens accumulated in the Dehra Dun Herbarum, which, it may be mentioned, contains specimens collected by Wallich and Roxburgh. He quotes Sir D. Prain ("Bengal Plants," p. 263) as writing, "It is not a matter for congratulation that we know less about trees so important as the Garjans than was known by English residents in Bengal 90 years ago." Mr Parker says he hopes to show that this is no longer true, and opens his series with an account of the Dipterocarps of Gaertner and Roxburgh. A further example is given of the necessity and usefulness of the present work. In the "Flora of British Indu" two species of Anisoptera are mentioned, namely, A. oblonga Dyer, described in 1874, and A. glabra Kurz, described in 1873. In the "Flore générale de l'Indo-Chine," published in 1910, these two Indian species are mentioned as "espèces incomplètement connues." The Anisopteras, like the Dipterocarps, are forest trees of the largest size, and it is highly desirable that they should not remain obscure; as if they extend into neighbouring regions such as Siam, Indo-China, and Malaya they will mevitably be renamed, if this has not already been done, thus causing a useless multiplication of names. Much of the material which Mr. Parker has had to work on, especially that from Burna, has been collected from marked and numbered trees which have been visited periodically by the forest staff in order to collect leaves, twigs, flowers, and fruits when available on the tree. The successful collection of specimens from big trees is not an easy matter when we picture the dimensions of one instanced 110 feet high, 7 feet girth, and 62 feet to the first branch! In the Part I. of Mr. Parker's series here dealt with he describes five species of Dipterocarpus (costata Gaertn., turbinatus Gaertn, pilosus Roxb., tuber. culatus Roxb., and alatus Roxb.). The series will be of undoubted value to the botanist, but it will be equally welcomed by the forest officer; for those who have worked in the Chittagong, Arrakan, Burma, and Andamans forests are well aware of the confusion which has reigned in the correct identification of these species of a fine genus of timber trees.

The Genera of Magnolies. In the Kew Bulletin (No. 7, 1927), J. E. Dandy gives the results of a much-needed critical study of the Magnoliese, in so far as it concerns the tribe Magnolies. For a long time much of the confusion which has existed in the group has been due to the various interpretations of the limits of the genera. The author has now been able to assemble at Kew for the first time the type specimens of nearly all the species of the tribe. By relegating the very distinct genus Liriodendron to a tribe of its own, he finds that the remainder of the family, the true Magnoliese, form an extremely natural group, about the number of constituent genera of which there has never been any uniformity of opinion. Ballon arranged the genera under five sections of the one genus Magnolia. The present study suggests that taxonomically Baillon's unigeneric view is untenable, and nine genera, four of them new, are recognised, namely, Talauma, Manglietia, Magnolia, Aleimus

omadendron, Pachylarnax, Elmerrilla, Micholia, il Kmeria. Ot the new genera, Aleimandra is a str-off from Michelia, on account of the terminal instead of axillary flowers; Pachylarnax is based on a species hitherto undescribed, and unique in the family on account of its capsular fruit, Elmerrillia resembles some species of Michelia in general appearance and in the axillary flowers, but differs in the sessile gynecium and introrsely dehiscent anthers, Kmeria (formerly Magnolia Diaperreana) has unisexual flowers and a mode of dehiscence quite unknown in the rest of the family.

Variation of Radioactivity of Hot-springs.—In the Science Reports of the Tohoku Imperial University, vol. 16, No. 5, K. Shiratori gives detailed results of the investigation of the radioactivity of hot-springs in the west of Honsyu, carried out in the summer of 1925, and compares his figures with those obtained by Ishizu, made in 1913–14. In the interval, the radioactivity of six springs has increased, whilst that of four springs has decreased. An earth-quake intervened in the interval.

Soundproof Houses.—Two recent papers of the Bureau of Standards (Scientific Paper 552 and Technologic Paper 337), by Mr. V. L Chrisler, deal with the building construction problem of preventing sound from passing from one room to another in a tenement house. Each wall of a room acts as a diaphragm fixed at its edges, but capable of being moved backwards and forwards at its centre by sound waves which impinge on it. The stiffer and heavier it is the less its motion and the less the sound it transmits to the room on the other side. With a compound wall having an air space, the intervening air acts as an ineffective connexion between the two surfaces, so that little sound is propagated through the wall. If, however, the two surfaces are connected by studs, struts, or cross ties, the transmission is greatly increased, and this is found to be true to some extent of many of the fillers which are at present introduced into the air space as sound insulators. It is recommended that the two surfaces of the wall should not be tied together in any way, and that the weight of each should be carried by felt pads.

CONDUCTION THROUGH METALS.—In a communication from the Physikalisch-Technischen Reichsanstalt, published in the Zeitschrift fur Physik (vol. 44, p. 615), E. Gruneisen and E. Goens have described some attempts to systematise the data on thermal conduction through metals of simple crystalline form, making use very largely of new values obtained by them for the conductivities between  $0^{\circ}$  C. and  $-252^{\circ}$  C. They have found that there is a linear relation between the reciprocal isothermal conductivities for heat and for electricity with different specimens of a substance, and suggest that the thermal conductivity is partly 'metallic' and partly non-metallic.' The former component satisfies the Wiedemann-Franz relation, and gives a value for Drude's constant which is close to that predicted from the theory of electrons, whilst the second component depends only on the temperature. The total resistance can be expressed in terms of the characteristic functions introduced into the theory of specific heats by Prof Debye. Although many of their measurements were made both with single crystals and with ordinary test-pieces, it is still uncertain if the size of the individual grains in the latter is of any consequence.

THE ANNEALING OF COLD - ROLLED STEEL.—
Edwards and Kuwada have studied the annealing of hom ad steel subjected to varying degrees of reduction

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by cold-rolling. Their results are stated in a paper read at the Glasgow meeting of the Iron and Steel Institute. The temperature at which the hardness begins to be removed falls as the degree of cold work is increased and the rapidity of the removal increases at the same time. Around 500° C, just before softening sets in, there is a distinct tendency for the hardness to rise somewhat. The most effective range of temperature for softening the steel lies between 550° and 650° C. The curious fact was observed that on annealing at 650°-750° C, specimens which had been subjected to an intermediate amount of cold work, 11 6-19 5 per cent, reduction, become softer than either the original material or that which has been either more or less severely deformed.

SILICA GEL AS A MEDIUM FOR DRYING BLAST.-Whether dry blast in iron smelting is, or is not, economically useful may perhaps be still a matter of opinion. A paper dealing with the application of silica gel for this purpose, read at the Glasgow meeting of the Iron and Steel Institute, however, appears to carry the subject a good deal further from the purely technical point of view. The main features of the use of the material from the blast-furnace point of view are that at room temperatures it can adsorb up to at least 20 per cent. of its weight of water with almost perfect efficiency, and that by raising the temperature to about 600° F., this water can be driven off, leaving the re-activated gel ready for another cycle. It is not advisable to reduce the water content below about 5 per cent and about 2 lb. of gel per cub. ft. of air to be treated a minute is required. A plant to deal with 35,000 cub ft. of air a minute has been erected and run satisfactorily for the past year. It consists of six units, of which five are in operation, while the sixth is being re-activated, the normal period for this being about 14 hours reducing the moisture in the blast to about 12 grains per cub ft., the output of the furnace has been considerably increased, with a distinct saving of fuel. The labour required is almost negligible, the power needed about 20 h.p., while the life of the gel appears to be long. Blast-furnace gas is used to supply the heat for the treatment of the gel, which, like the air needed for the combustion, is filtered before use. The dehydration of the blast can be carried much below the present figure if it be desired, and the figure of 0 1 grain of moisture a cub. ft. is mentioned.

THE CONSTITUTION OF GENTISIN.—The constitution of gentism, first isolated from gentian root in 1821, has been definitely settled by the synthesis of the only possible alternative substance, which was found to have different properties from gentism. Gentism is the monomethyl ether of gentisein, which in turn is 1:3:7-trihydroxyxanthone. The work, by Shinoda, is described in the August number of the Journal of the Chemical Society.

Synthesis of Taurine. -Taurine, 2-amino-ethyl-sulphonic acid, occurs in the tissues of various lower animals and in secretions of higher animals, where it is probably formed from the amino-acid, cystine. It has been synthesised by several methods, first by Kolbe in 1862, but these are unsatisfactory. Marvel, Bailey, and Sparberg, in the July number of the Journal of the American Chemical Society, show that a modification of a method proposed by Köhler in 1898 gives fairly satisfactory yields. It consists in treating 2-bromo-ethylsulphonic acid or its sodium salt with aqueous ammonia to give a mixture of taurine and sodium bromide, from which pure taurine is easily obtained by crystallisation from alcohol. Full experimental details are given in the paper.

# Leipzig Meeting of the International Commission for the Exploration of the Upper Air.

URING the week Aug 28-Sept. 3, the ancient city of Leipzig was the scene of an exceptionally well-attended meeting of the International Com-mission for the Exploration of the Upper Air. Of the European countries, members of the Commission were present from Norway, Sweden, Denmark, Russia, Poland, Hungary, Austria, Germany, Holland, Great Britam, France, Spain, Italy, and Greece. Extra-European countries were represented by Dr. H. H. Kimball, of the Weather Bureau of the United States of America, and by Dr. Ooishi, the Director of the Aerological Observatory of Tateno, Japan. Sir Calbert Walker, though no longer holding an official position, may perhaps be regarded as having established contact with India Letters expressing regret for unavoidable absence were read at the opening meeting from various other members from over-seas

The main business before the meeting was the consideration of a specimen volume containing the observations in the free atmosphere made on the international days of the year 1923 which the bureau of the Commission had been charged to prepare The question of reviving the arrangements for publishing in collective form the data referring to the international days has been before meteorologists ever since the termination of the War, which had brought the old arrangement to an abrupt conclusion. It was discussed in detail at a meeting of the Commission held in Bergen in 1921, but it was found impossible to evolve a practical scheme or even to formulate the basis on which international contributions to the cost should be asked for. The matter dragged on until 1924, when it came before the Meteorological Section of the International Union of Geodesy and Geophysics. That body came forward with the suggestion that the preparation of a specimen volume containing one year's observations would afford the best means of furthering the enterprise on the principle e'est le premier pas qui coûte, and allocated from the funds at its disposal a sum of £500 for the purpose. That sum was afterwards increased by contributions from other sources and it became possible to take the work in hand. The general lines which the publication should follow were agreed upon at a meeting of the Commission held in London in April 1925, and the task of preparing it was entrusted to the president, Sir Napier Shaw, and secretaries.

The volume submitted at Leipzig represents the result of their labours. It is in tour parts. Part 1 (p. 28), the introduction, sets out the Règlement approved by the Commission in London for the guidance of the editors. It enjoins the use of systematic units and the specification of geopotentials in place of the more usual geometric heights. This has rendered necessary conversion tables and some further explanation of the methods of applying the règlement adopted by the editor. The Introduction ends with a list of stations co-operating in the international investigation of the upper air during 1923 and 1924, with their co-ordinates and geopotentials, and also the local time corresponding with G.M.T.

Part 2 (p. 40) consists of an index of the data available for each international day, and a collection of synoptic charts showing for each of the days the distribution of pressure over the whole world. This is probably the first occasion on which charts have been published showing the distribution over both hemispheres. The information has in general been compiled from the daily weather reports of the

For the northern hemisphere, various countries thanks to the daily maps of the Pacific Ocean published in Japan, and the corresponding information available in the Meteorological Office for the Atlantic, representation by means of isobars has been possible over the greater part of the area. For the southern hemisphere, much of the information has been supplied specially Representation by isobars is confined to the land areas; for the oceans it has only been possible to give individual readings representative of observations on islands or ships. The inclusion of world maps in a volume devoted to observations of the upper an is eloquent testimony that the study of the upper air has become truly international and world-wide in its scope. The maps form a standing challenge, on one hand to meteorologists in the regions remote from the areas directly controlled by the larger meteorological services to contribute their share to the common stock, and, on the other hand, to those working in the meteorologically more favoured regions to think in terms of world meteoro-

Part 3 (p. 148) sets out the data in tabular form. The British reader will note with satisfaction that m addition to the observations from British and Canadian stations, the Empire is represented by pilot balloon observations from Australia, Ceylon, South Africa, Samoa, and Hong Kong The labour of presenting the very heterogeneous material submitted by the individual co-operators in the homogeneous form enjoined by the Commission's règlement has been very great, but the task once achieved, the volume forms an invitation to all to adopt the standard form in the primary tabulation of their meteorograms, whereby the task devolving on future editors would be much reduced. It is indeed a case of the first step being the most expensive, but it must of course be borne in mind that, as the years go by, the number of co-operators and the amount of material they will supply is bound to increase.

Part 4 (p. 20) consists of a collection of tephigrams, or entropy - temperature diagrams for the ascents of registropy; bulkeyer

of registering balloons.

Such was the specimen volume 1 submitted to the Commission. Its printing has been entrusted to the Cambridge University Press, which fact may be taken as a guarantee that the selection of types and printing leaves nothing to be desired. A considerable part of the time of the meeting was taken up in exploring the possibilities of making provision for the publication of similar volumes for future years. Such volumes might be regarded as complementary to the annual volumes of the Réseau Mondial published by the Meteorological Office, which gives a monthly résumé of surface conditions for the whole world. Ultimately it was decided that an appeal, signed by the past and present presidents of the Commission, Sir Napier Shaw, Prot. V. Bjerknes, and Dr. Hergesell, and by the president of the International Meteorological Committee, Dr. E. van Everdingen, should be circulated to all Meteorological Offices asking for annual contributions to the cost of the publication.

Considerable discussion arose on the question of the use of geopotential in preference to the more usual geometric height as the vertical co-ordinate. From the point of view of organisation, the question is one of considerable importance, for on it depends whether

Copies may be obtained from the Secretary of the International Commission for the Exploration of the Upper Air, c/o The Royal Meteorological Society, 49 Cromwell Road, S.W.7. Price, £2.

Tervers, when tabulating the traces of their cteorographs, should evaluate the pressures, tem-fratures, etc., corresponding with specified geopotentials, or whether they should be asked to give corresponding values for specified heights. It is scarcely practical politics to call on them to undertake the labour of tabulating in both forms or to print both sets of results in extenso. The reglement approved in London in 1925 specified the meteorological values corresponding to the geopotentials 1000, 2000, 3000 . . dynamic metres, but the editors of the specimen volume found themselves unable to comply with that instruction, as the data for 1923 had been submitted by the co-operators before the date of the London meeting and had been computed for steps of 1000 (geometric) metres The corresponding evaluation for steps of 1000 dynamic metres can only be satisfactorily performed by reference to the original records, and the editors had perforce to give the data "aux hauteurs kilométriques définitives au lieu des niveaux géodynamiques". The Leipzig meeting reassimmed the decision taken in London two years earlier, and it thus remains an instruction to the editors of future volumes to publish the values for specified geopotentials as soon as the material shall be available in that form, and an invitation to cooperating observers to reduce their observations in that manner At the same time, there was a strong feeling that geometric height should not be entirely eliminated from the publication, and a small subcommission was appointed to consider what modifications of detail could be made in the tables in order to give heights as well as geopotentials

Among other matters of organisation which came before the Commission was the selection of the days for combined international ascents for future years In this matter the Commission followed the programme drawn up at Bergen m 1921, but, in deference to a suggestion by Prof. Exner that the international ascents should be used so far as possible for the investigation of specified meteorological conditions, it was agreed that the president and the regional vice-presidents should not be expected to restrict to the 'international month' their choice of days on which special ascents are made in response to notice circulated by telegram or broadcast. October was specified as the international month for 1927 and March that for 1928.

Attention was also devoted to organising the arrangements for preparing and publishing the observations of pilot balloons for the twelve months commencing July 1, 1917, from the very close network of observing stations that existed during the War. This proposal had been remitted to the Commission by the International Meteorological Committee at its meeting in Vienna in 1926.

Though the greater part of the time of the meeting was taken up with the discussion of questions of organisation, time was found at the afternoon meetings to bring forward a number of purely scientific questions and to receive reports of progress m various branches of upper air work. Summaries of these will be published in due course as appendices to the official report of the meeting.

At the penultimate meeting, the Commission was called upon to make choice of a new president, as Sir Napier Shaw had intimated his firm intention of vacating the arduous post which he has filled with such distinction for so many years. Upon the motion of M Wehrlé, of the Office Nationale de France, Dr. Hergesell, the Director of the Lindenberg Observatory, was unanimously elected president. In proposing Dr. Heigesell, M. Wehrlé referred in a tew well-chosen words to the eminent services which he had rendered to the study of the upper atmosphere during his tenure of the office of president during the years prior to the War. Sir Napier Shaw was mvited to accept the position of honorary president Dr C. W. B. Normand, Director-General of Indian Observatories, was elected vice-president of Region D (India and Philippines) in succession to Mr. J. H. Field. Dr Marvin remains vice-president of Region A (North America), and Dr. Th. Hesselberg (Oslo) and Mr. R. G. K. Lempfert will continue to act as secretaries of the Commission.

This account of the meeting would be incomplete without some reference to the cordial welcome extended to the Commission by the Saxon Government, the University and the Municipality of Leipzig, and by the authorness of the Leipziger Messe. The Minister for Volkswirtschaft, the Rektor of the University, and the Mayor of Leipzig attended the opening meeting to welcome the members of the Commission, at which Dr. Hergesell also spoke a few words of welcome on behalf of the authorities of the Reach. The Minister afterwards took the chair at an official dinner. The authorities of the Messe not only put their organisation for providing lodging ungrudgingly at the service of the Commission, but also invited the members to pay an official visit to the technical section of the Fair. The Municipality entertained the members at a special performance at the Opera Last, but not least, all who attended the meeting will feel that they owe a special debt of gratitude to Prof. L. Weickmann, the Director of the Geophysical Institute of the University, in which building the meetings were held, for the excellent arrangements made for their comfort. Nothing could have exceeded the care with which Dr. Weickmann and his staff had thought out in advance all details which could contribute to the success of the meeting. R. G. K. L.

#### Grouse Disease in Norway.<sup>1</sup>

WE have recently received a memoir by Prof. August Brinkmann on coccidiosis in the willow grouse (Lagopus lagopus) which forms communication No. 16 of the comprehensive investigation on the biology of this bird undertaken by the Bergen Shooting and Fishing Society. The object of this investigation, which is on similar lines to that of the British Grouse Commission, is to inquire into the causes of the fluctuation in the stock of willow grouse.

Prof. Brinkmann found that the development in the willow grouse of *Emeria avium*, the causal organism of cocodosis, agrees in general with the account given by Prof. Fantham of its development in grouse. It differs from the Eimeria arium of hom 'ergens Museums Aarbok, 1926, Naturv. 1ackke, No. 9 (1927).

domestic fowls and turkeys in that the large subepithelial cysts with their numerous merozoites found in these birds are not present in the willow grouse. Oocysts from the willow grouse are on the average larger than those from the fowl, and they are shorter but broader than those from the grouse; their size and shape, though their variations overlap those from other birds, stamp them nevertheless as a particular type, supporting Vervey's view that Eimeria arium is to be found in various birds as phenotypes more or less different in form.

Examination of the willow grouse shows that the jejunum was most generally infected and that the duodenum was also frequently infected. In both these parts of the intestine the whole life-cycle of Emeria takes place; the duodenum does not appear to be, as in the grouse, the special site of schizogony. The cacum may be tull of cocysts, but its epithelium is always free from the intracellular stages.

In the willow grouse cocedosis is especially a disease of young birds—75 per cent of those examined were infected. It is also common in the adult birds, 49 per cent, being found infected, but the infection is much more severe in the young birds. The number

of parasites present in severe cases has been estimated to be several millions.

The course of the infection is similar to that in grouse; if the young bird survives the acute stage, the disease passes into a chronic stage, during which oocysts are produced, though in meagre numbers, for a protracted period. Severely infected birds fly little if at all when they are flushed, nor do they try to bide themselves, but remain sitting in quite open ground.

and can easily be taken with the hand

In a concluding chapter, Prof. Brinkmann points out that investigations in Norway during the last ten to fifteen years show that neither migrations, meteorological conditions, not the toll taken by beasts of prey and by man can be considered as having had any decisive influence on the increase or decrease of the stock, but that the decrease must be due to the epizootics by which the stock has been ravaged from time to time. The only known epizootics of the willow grouse are those due to coccidiosis, for hitherto the presence of Trichostrongylus pergracilis, the nematode worm which causes great mortality among adult grouse, has not been proved. Moreover, the known tacts indicate that it is the disease in the young willow grouse which decinates the stock, and that improvement in the stock is correlated with a decrease in the disease

In the fluctuations in the stock of willow grouse until the 'inneties, the intervals between the good years were of fairly short duration—a few years only—but the last bad period has extended from the year 1912-13 to the year 1925-26, which suggests that

some new factor is exerting an influence. P Brinkmann considers this new factor to be the her toll which has been taken of the Norwegian birds He regards as proved that birds of prey have a tayourable effect on the stock of birds, as they take more of the sick than of the healthy buds. One result of the decimation of birds of prey was an enormous increase in the stock of willow grouse which culminated in 1911. But as no attempt was made to preserve the stock by having gamekeepers to collect sick and dead game and to cleanse infected areas by burning the heather--which would have been impossible under Norwegian conditions-the result was a complete collapse of the stock. This was due to a violent epizootie (coccidiosis) which, because the coveys lay very close together in the summer, had exceptionally tavourable conditions for development. The epizootic has continued year after year, and it was not checked until the stock had become much reduced. The coveys then lay so far apart during the breeding season that the risk of infection was considerably diminished.

Coccidiosis appears to be endemic almost wherever grouse are found, Prof Brinkmann states that he has proved its occurrence in Iceland and Spitsbergen Vervey's view that coccidosis in different kinds of birds is due to a series of phenotypes of the same parasite, Eimeria avium, which can be transferred from one species of bird to another, is in accord with the Norwegian observations that there was coccidiosis simultaneously among willow grouse, ptarmigan, black game, and capercarlzie, and that at the time when the epizootic was at its height the small birds also disappeared in various places. On these grounds, Prof. Brinkmann concludes that it would be impossible to exterminate Eimeria arium. He recommends less destruction of the birds of prey so as to endeavour to return to the conditions before the 'nmeties, when, though there were fluctuations in the stock of willow grouse as great as they are new, the

bad periods were of shorter duration.

#### Sex-change in the Oyster.

A LONG and fully documented paper by Dr. J. H. Orton (Jour Marine Biol. Assoc., 14, 4, May 1927, pp. 967-1045) forms Part I. of an account of the observations and experiments which he has been carrying out for some years past on sex-change in Ostrea edulis; it deals with the change from female to male. The sex-physiology of the oyster well ments elaborate study, and Dr. Orton has been successful in clearing up many debatable points and giving a coherent account of the curious phenomena myolved.

The material examined by Dr. Orton has been extensive; more than 1000 female-functioning systers at about the time of spawning and at intervals thereafter have been closely examined for the purposes of this part of the work. While a number of undoubted hermaphrodites exist, and some curious inter-sexual types, Dr. Orton confirms the view of Hock and Mobius that the syster is bisexual. But alternation of sex is the rule. The data clearly show that, except for a small percentage of abnormal individuals, all female systers normally change their sex immediately after spawning and develop ripe sperm before their larvæ are set free in the water. Functional maleness continues as a rule for one or two months, when the gonad becomes quiescent; after this period a proportion revert to the female condition and produce eggs. There is reason to suppose that a regular, probably annual, alternation of sex occurs normally.

As to the cause of this swift change over from

female to male, Dr. Orton suggests that it is due to a metabolic rhythm characteristic of the species, whereby the type of metabolism perhaps prodominantly a protein metabolism associated with femaleness changes over to the type associated with maleness—perhaps a carbohydrate metabolism. The hypothesis is advanced that the accumulation of unusable products of the one kind of metabolism is the stimulus for the change over to the other.

Dr. Orton's observations on sex-change in the oyster have led him to discuss in a short but suggestive paper (loc. cit., pp. 1047-55) the fundamentals of a theory of sex-determnation. The sex-chromosome theory clearly breaks down in cases of regular alternation of sex, and Orton proposes in its stead a metabolic theory of sex. He suggests that the X- and Y-chromosomes when present have the function of superimposing upon the general metabolism of the species a metabolism of a particular type to which the gonad responds by producing eggs or sperm. But the same sex-modification of metabolism may be brought about by other means than the sex-chromosomes, as by some fundamental change in the rhythm of metabolism related to the conditions of life

The attempt at a physiological interpretation of sex and of the action of the sex-chromosomes is of course not new, but there is little doubt that such attempts are in the right direction. Dr. Orton's contribution, both of fact and of interpretation, to this difficult.

problem merits close attention.

## Competition and Economic Equilibrium.

DROF. J. SCHUMPETER, a distinguished German economist of the University of Bonn, contributed an interesting paper on "The Instability of our Economic System" to the proceedings of Section F (Economic Science and Statistics) of the British Association at the recent meeting in Leeds pounding the question "In what sense can the present economic system of capitalist production and distribution be said to contain possible causes of instability?" Prof Schumpeter said that by the phrase 'capitalistic system' he understood an economic order characterised by (1) Private property and private initiative; (2) division of labour or production for the market; and (3) credit creation by banks, which latter he considered an essential element of that system Neglecting disturbances which might arise from without the economic sphere and would react on economic life, for example, reactions of a policy of deflation in certain circumstances, he showed that the capitalistic system is in itself economically stable, and would not show any tendency to outgrow the elements of which it consists, and would therefore last indefinitely if left to itself.

Prof. Schumpeter pointed out that, as has been demonstrated by the economic analysis of which the late Dr. Marshall is the greatest exponent, there is to be found under competitive conditions a stable equilibrium of the economic process, to which in given circumstances real life tends to conform. This theorem, it has to be admitted, is not accepted by the 'man in the street,' who, on the contrary, is in the habit of attributing all sorts of instability to competition, though this he usually does under mis-But though competitive conditions apprehension prevailed during the nineteenth century with sufficient approximation to theoretical hypotheses, Prof. Schumpeter pointed out that they certainly do not prevail at the present time, and it is therefore necessary to prove a similar proposition in the case where monopoly is the rule among various industries. This is not so easy a task, and there are many economic authorities who do not admit that a stable equilibrium of economic life can exist in this case. Nevertheless, such equilibrium can be shown to exist. It can also be proved that the increase of population is never by itself a cause of economic instability.

Prof. Schumpeter next went on to explain that there remains the fact that the business cycle destroys the state of equilibrium, which may have established itself. The business cycle cannot be accounted for by outside impulses such as harvests, wars, and so on, but is, on the contrary, the necessary form which economic evolution takes under capitalistic conditions. But although every boom destroys an equilibrium, every depression tends to establish a new one, and there is nothing in these recurring waves of prosperity and depression to affect the capitalistic system as such, nor are extensions and contractions of banking credit causes of instability.

Economic stability, however, Prof. Schumpeter stated, does not imply or guarantee political or social stability, and a position of stable economic equilibrium may be socially or politically unstable. For a variety of reasons the political and social circumstances of our time are in fact unstable in the highest degree. By its own working the capitalistic system evolves a mentality and a way of arranging life and looking at life which is bound to undermine what are regarded as indispensable psychological bases of capitalistic sociaty.

Our modern attitude towards taxation, inheritance, home life, etc., which attitude is not dependent on

economic necessities, are illustrations of the development of this psychological process. The capitalistic system provokes discussion, and discussion is the beginning of all revolutions. When psychological reactions have proceeded far enough they may exert a destructive effect on the system itself by removing the motives which have been the mainsprings of that system. People may get into a mental attitude in which they would do away with the economic system without any economic pressure and even against economic interests. If the capitalist system passed away in that fashion many other things would necessarily die, including even, as a possibility, family life as we now know it.

#### University and Educational Intelligence.

ST Andrews.—At the autumn graduation ceremony on Friday, Oct 7, the Vice-Chancellor, Sir James Irvine, announced that the donor of the gift of £100,000 to the University was Dr. E S Harkness, of New York, well known on both sides of the Atlantic for his generosity in the cause of education than one-fourth of the gift was allocated by the donor towards the cost of building a new residential hall for men students. The intention is to restore the old collegiate system which was a feature of university life until a century ago. The honorary degree of LL D. was conferred upon Prot. John Burnet, who has just retired from the Chair of Greek in the University; Sir Richard Gregory, Dr. Knud Rasmussen, Copenhagen, the Arctic explorer; and Mr. Benjamin Thomson, Rector of Forfar Academy

Co-operation between universities and industrial and commercial firms is increasingly close and effective in the United States and is being systematically fostered by the American Council on Education. Remarkable progress has been made in developing ways and means of securing for educational institutions suitable kinds of trustworthy occupational mformation. Large industrial organisations have co-operated in the task of formulating detailed specifications of the work required to be done by the various classes of persons employed by them, and these 'job specifications,' as they are called, have been proved to be of great value both to schools and colleges and to the employers. The following description of methods of co-operation between the Yale University Bureau of Appointments and the industrial organisations with which it is in touch is based on an article published in the April number of The Educational Record. The Bureau is in touch through its bulletins with about 1200 firms, and almost daily from early in March until late in May, representatives of one or more firms, frequently one of the chief executives, attend at the Bureau to interview undergraduates in their final year. Even where the interviews do not lead directly to appointments they are useful to the undergraduates, for m most cases the firm's representatives are glad to give general vocational advice and talk freely and helpfully even with candidates who are not so much interested in the particular company represented as in obtaining specific occupational data, which is, in fact, regarded by many as the most valuable advantage of the When applying for interview dates—and scheme. many more apply than can be accommodated—the firms furnish an outline of the positions to be filled, salaries offered, nature of work, etc., which enables the undergraduates to judge which representatives they wish to see.

#### Calendar of Discovery and Invention.

October 16, 1759 -The building of Smeaton's Eddystone lighthouse occupied the summers of 1756–1759, and the light was first exhibited on Oct. 16, 1759. The lighting apparatus consisted of 24

candles held in a bronze frame

October 16, 1843.—The name of Hamilton is now chiefly associated with the memorable invention of the calculus of quaternions, of which Hamilton wrote in 1858 to the Rev. J. W Stubbs: "To-morrow will be the fifteenth birthday of the Quaternions. They started into life full-grown on the 16th October 1843, as I was walking with Lady Hamilton to Dublin, and came up to Brougham Bridge-which my boys have since called Quaternion Bridge. I pulled out a pocket-book which still exists, and made entry, on which at the very moment I felt that it might be worth my while to expend the labour of at least ten or fifteen years to come." In another letter, written some years atterwards, Hamilton said: "Nor could I resist the impulse—unphilosophical as it may have been-to cut with a knife on a stone of Brougham Bridge, as we passed it, the fundamental formula which contains the Solution of the Problem.'

October 17, 1741.—On this day Linnæus, who had himself travelled in Lapland, Denmark, Germany, Holland, France, and England, pronounced before the University of Upsala his "Oratio de Peregrinationum intra Patriam necessitate." He displayed the usefulness of such excursions, by pointing out to the students that vast field of objects which their country held out to their cultivation; whother in geography, physics, mineralogy, botany, zoology, or economics; showing the benefit that must accrue to themselves and their country as rewards of their diligence.

October 18, 1892.—In the development of long distance telephony in America, Theodore Vail played a leading part. He first connected Boston with Salem, then Boston with New York, and on Oct. 18, 1892, New York was connected with Chicago, Graham Bell being the first to speak over the new line.

October 20, 1868.—Sir Norman Lockyer's notable spectroscopic discoveries were made known to the Royal Society in a letter dated Oct. 20, 1868, in which he stated: "I have this morning perfectly succeeded in obtaining and observing part of the spectrum of a solar prominence. As a result I have established the existence of three bright lines in the following positions:—(i) Absolutely coincident with C. (ii) Nearly coincident with F. (iii) near D."

October 20, 1880.—The first public lighting of a

hall in Great Britain by means of the meandescent electric lamp was carried out by Swan on Oct. 20, 1880, in the rooms of the Literary and Philosophical

Society of Newcastle.

October 21, 1824.—The home of the portland cement industry was Leeds, where Joseph Aspdin, a stonemason, discovered that by mixing finely pulverised lime with clay in certain proportions, burning it at a high temperature, and then grinding the product to powder, he obtained a new building material which, with the addition of water, when set, produced a block resembling Portland stone. He took out a patent for his invention of 'Portland cement' on Oct. 21, 1824. A century later a memorial to him was placed in Leeds Town Hall, when it was stated that the annual production of portland cement was 50,000,000 tons.

October 22, 1797.—The use of the parachute as a means of descending from balloons was due to the French aeronaut, Garnerin, who made his first descent with one on Oct. 22, 1797

#### E. C. S.

#### Societies and Academies.

CAPE TOWN.

Royal Society of South Africa, Aug. 17 -- A. J. Hesse: Some new species of Curculionida from South Africa and South-West Africa. The total  $number\ of\ Hipporrhinus\ species\ has\ been\ increased\ trom$ 146 to 152. The genus Solenorrhmus, which up to now was composed of only I species, has been enriched by 2 other new species, one of which is found on the Silverleaf trees on Signal Hill. Two of the Curculionidae described are found in such widely separated areas as Zululand and South-West Africa and Transvaal and South-West Africa .- P. R. v. d. R. Copeman: Studies in the growth of grapes, Part 4: The initial changes in acidity During the initial stages of growth of the berry, the changes in acidity of the juice are autocatalytic.—F Dixey: The Dinosaur Beds of Lake Nyasa. A series of sediments occurring along the north-western shores of Lake Nyasa have yielded a number of interesting Dinosaur remains which are allied to the better-known deposits of Tendaguru. The beds consist principally of a great thickness of friable sandstones, sandy marls, and clays. They lie unconformably on older rocks which are affected by post-Karroo faults; and are themselves faulted and overlain by more recent deposits of the Nyasa trough.—S. H. Haughton: On some reptilian remains from the Dinosaur Beds of Lake Nyasa. It has been possible to identify two forms specifically; and many other bones can definitely be assigned to the Sauropoda. The forms named are Platycheloides nyasæ gen. et. sp. n., the first recorded African Mesozoic testudinate, and Gigantosaurus dixeyi sp. n., a sauropod allied to a form described from Tendaguru. -- D. Thoday and M. A. Pocock: On a Myosurus from South Africa, with some notes on Marsilia macrocarpa. The discovery is recorded of a species of Myosurus, a genus new to South Africa. It is identified provisionally, in the absence of material with ripe achenes, as Myosurus Minimus.

#### Washington, D.C.

National Academy of Sciences (Proc., Vol. 13, No. 8, August). -- Carl H. Eigenmann and George S. Myers A new genus of Brazilian characin fishes allied to Bivibranchia E. F. B Fries: Nervous control of xanthophore changes in Fundulus. The killifish changes in colour to correspond with its background by means of the expansion and contraction of melanophores and xanthophores. Control of the latter is mainly through a discriminating pigmentmotor centre in the central nervous system. -Solig Hecht: A quantitative basis for the relation between visual acuity and illumination. Keenig found that visual acuity increases nearly as the logarithm of the intensity of illumination; hence the number of rods and cones in the retina can be varied functionally. This can be accounted for quantitatively by assuming that the sensibilities of the individual rods and cones vary about a mean in a manner similar to that in which a population varies. lowest intensities, vision is by the rods; then the cones begin to function, and since they come into action ten times as fast as the rods, visual acuity becomes a function of the foveal cones and increases to a maximum. Observations on colour-blindness can also be explained.—David White: The flora of the Hermit Shale in the Grand Canyon, Arizona. This shale constitutes the upper 300 ft. of the red beds in the Grand Canyon and is of Lower Permian age. The flora includes European conifers and pteridosperms and many Uralo-Asiatic forms, it indicates a dry chimate possibly not much number that of northern New Mexico at

esent day.—William H Gates: Linkage of short Gr and density in the house mouse. Linkage appears to be complete.—Willard J. Fisher: Note on corrections to H. A. Newton's "1850 dates" of meteor showers -Carl Baius: Reciprocating acoustic vibration on opposite sides of the pinhole, in long quill tubes.—Walter A. MacNair and A. Ellett: Explanation of the incomplete polarisation of mercury resonance radiation.—E. C. Watson: The spacedistribution of the photo-electrons ejected by X-rays Using unpolarised X-rays, the distribution of electrons about the direction of the X-ray beam has a maximum a little forward of perpendicular to the X-ray beam and falls to zero at about 90° on each side of the maximum; it is asymmetrical, particularly with high frequency X-rays Using polarised X-rays, the distribution has a maximum in the direction of the electric vector and does not fall to zero at 90° from this direction; it is symmetrical, but the maximum is less than in the former case. The theory of nuclear scattering explains these effects —Earl E. Libman. Surface tension of molten metals. (1) Copper. The method used is to measure the depression of surface caused by a vertical plate and a vertical tube which are not wetted by the liquid. Copper is inelted in a high vacuum molybdenum wound furnace in a crucible with lid combining a plate and a tube. An X-ray photograph is taken through the entire furnace and the levels of the liquid measured on the photograph. The 'capillary constant' (2 x surface tension/density  $\times g$ ) for copper in contact with its vapour varies from  $0.308 \pm 0.0017$  at  $1083^\circ$  to  $0.297 \pm 0.0017$  at  $1318^\circ$ . The effect of impurities increases with rise of temperature.—A. Keith Brewer. The relation between temperature and work function in thermionic emission. Gas molecules approaching a surface are dissociated into ions by forces regarded as composed of an electrostatic image force, which has the same effect on both ions, and an intrinsic force, which holds one ion more firmly than the other. These forces are opposed by the kinetic energy of agitation. Hence as the temperature rises, the more lightly held ion escapes first. For pure metal surfaces, positive ions escape first; for oxidised surfaces, the negative ions are released first.—F. A. Saunders: On the spectrum of argon in the extreme ultra-violet.-P. R. Heyl: A redetermination of the Newtonian constant of gravitation (see Nature, Oct. 8, p. 529).—Jesse Douglas: Contact transformations of three-space which convert a system of paths into a system of paths.—M. S. Knebelman: Motion and collineations in general space.—G. A. Miller: Felix Klein and the history of modern mathematics.—S. Lefschetz: The residual set of a complex on a manifold and related questions.—Gilbert N. Lewis and Joseph F. Mayer: A disproof of the radiation theory of chemical activation. Pinene was passed at very low pressure through a quartz tube heated by platinum spirals to about 1000° K. At the pressure used there was negligible screening of one molecule by another and a negligible number of collisions because the mean free path was longer than the gas Under these conditions, energy sufficient for about 10 per cent. racemisation is available but no racomisation was detected.—James H. Hibben: Radiation and collision in gaseous chemical reactions. Nitrous oxide and ozone were submitted to infra-red radiation at different pressures; no increase of reaction velocity was observed. The bimolecular decomposition of nitrous oxide at low pressure is entirely heterogeneous. There is no change in the reaction rate of the unimolecular decomposition of nitrogen pentoxide at pressures of 0.2-0.002 mm. hom ala for artificially deformed crana.

#### Official Publications Received.

Publications of the Domminon Astrophysical Observatory, Victoria Vol. 3, No. 18. The Orbits of Two Spectroscopic Binaries. By S. N. Hill. Pp. 349 562. Vol. 1, No. 1. Three Peculiar Spectra, By J. S. Plaskett Pp. 20+3 plates. Vol. 1, No. 2. Three Long-Period Spectroscopic Binaries Statis. By Reynold K. Young. Pp. 27-18. (Ottawa. F. A. Actand.) Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1927. Pp. 42. (London. II M. Stationery Office.) 18. 3d. net. Journal of the Manchester Expiration and Onental Society. No. 13. Pp. 67. (Manchester. At the University Press, London. Longmans, Green and Co. Ltd.) 7.8 cd.

Journal of the Chemical Society. contuming Papers communicated to the Society. September. Pp. v+vi+2023-2388. (London. Gurney and Jackson.)

Jackson )

Annual Breeding Research Department, The University, Edimburgh. Report of the Director for the Year April 1st 1926 to March 31st 1927 (being the 7th Annual Report) Pp 40 (Edimburgh)

The Half-Yearly Journal of the Mysore University Vol 1, No 2, July Pp. 93-196 (Bangalore Bangalore Press) 2 tupees

Transactions of the Royal Society of Edimburgh. Vol. 55, Part 2, No 18 Jurassic and Ecoene Echimodea from Somaliand By Di Ethel D Currie Pp. 411-441+1 plate. (Edimburgh Robert Grant and Son, London Williams and Norgate, Ltd.) 48.

Agricultural Research Institute, Pusa Bulletin No 106 Sampling for Rice Yield in Bihar and Orissa. By J. A. Hubback Pp. 23—7 annas, 8d. Bulletin No, 167—A Scheme of Glassification of the Varieties of Rice found in Burma By R. A. Beale. Pp. 14+1 plates. 6 annas, 8d. (Calcutta Government of India Central Publication Branch)

Gramophone Records of the Languages and Dialects of the Madras Presidency Text of Passages Pp. vi+124. (Madras Government Press.) 14 rupees.

Giamophone Records of the Languages and James of the Presidency Text of Passages Pp. v1+124. (Madras Government Press.) 1 i rupee.

The Edinburgh and East of Scotland College of Agriculture. Calendar for 1927-1928 Pp. 96. (Edinburgh)
Union of South Africa. Department of Mines and Industries. Geological Survey. The Geology of the North-Eastern Part of the Spungbok Plats and surrounding Country. An Explanation of Sheet 17 (Spungbok Flats). By Dr. Percy A Wagner. Pp. 104. 2s. od. Sheet 17 Springbok Flats. 2s. 6d. (Pretona: Government Printing and Stationery Office)

Department of the Interior U.S. Geological Survey Bulletin 702-A; Mineral Industry of Alaska in 1925 and Administrative Report By Fred H Motht (Mineral Resources of Alaska, 1925-A) Pp. n.+49+vii. Bulletin 792-B. Geology of the Kink-Matanuska District, Alaska, By Kenneth K Landes, (Mineral Resources of Alaska, 1925-B.) Pp. n.+51-72+1 plate. Bulletin 795-A Manganese-bearing Deposits near Lake Crescent and Humpathys, Washington, By J. T. Pardee, (Contributions to Economic Geology, 1927, Part I.) Pp. n.+24-2 plates. 10 cents. Bulletin 795-B; Potash Brines in the Great Salt-Lake Desert, Utah. By Thomas B. Nolan. (Contributions to Economic Geology, 1927, Part I.) Pp. n.+24-1+1 plate. 10 cents. Bulletin 795-C Organic Precipitation of Metallic Copper. By T. S. Loveting, (Contributions to Economic Geology, 1927, Part I.) Pp. n.+45-52. 5 cents. (Washington, D.C. Government Printing Office)
Department of the Interior: U.S. Geological Survey. Professional

Department Frinding Office)

Department of the Interior U.S. Geological Survey. Professional Paper 118. Geology and Ore Deposits of the Leadville Mining District, Colonado, By S. F. Emmons, J. D. Irving and G. F. Loughlin, Pp. xyr+368+70 plates. (Washington, D.C. Government Printing Office)

250 dollars
Santhsoman Institution United States National Museum Bulletin
140 Bird Parasites of the Nematode Suborders Strongylata, Ascardata
and Spirinata By Eloise B Cram. Pp vvn+465 (Washington, D.C.
Government Printing Office) 85 cents
Santhsoman Miscellaneous Collections. Vol. 80, No. 3: Fossil Footprints from the Grand Canyon. By Charles M Gilmore Second Contribution (Publication 2917.) Pp n+78+21 plates (Washington, D.C.:
Smithsoman Institution)
Medeideelingen van het Geologisch Institut der Landbouwhoogeschool, Wageningen (Holland). No. 10: Bijdrage tot de kennis van
Pseudo-Gaylussiet Door Prof. J. van Baren. Pp. 25+8 afb. (Wageningen. H. Veenman en Zonen.)
Reprint and Circular Series of the National Research Council. No. 78:
Fifth Report of the Committee on Contact Catalysis. By E. Emmet
Reid, in collaboration with other Members of the Committee. Pp. 31,
50 cents. No. 79. Third Census of Graduate Research Students in
Chemistry By Clarence J. West and Callie Hull. Pp. 3. (Washington,
D.C.: National Academy of Sciences)

#### Diary of Societies.

SATURDAY, OCTOBER 15

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS

NORTH OF ENGLAND INSTITUTE OF MINING AND MFCHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2 30—M. Ford Presidential Inaugural Address—H T Foster, Notes on an Inrush of Water at the Montagu Colliery, Scotswood, Northumberland, on March 30th, 1925—The following paper will be open for further discussion:—The Dry Cleaning of Coal, by J. S. Carson
Physiological Society (in Physiological Laboratory, Guy's Hospital Medical School), at 3 30—H. F Hewitt and H. Florey. Effect of Drugs on Protein Content of Cerebro-Spinal Fluid of Rabbits.—H. Florey and H. M Marvin. The Blood Pressure Reflexes of the Rabbit under Urethane Amesthesis—Lk. S. Atken and A. E. Clark Kennedy; The Concentration of CO<sub>2</sub> in Successive Portions of an Expired Breath.—Dr. J. H. Burn and H. W. Ling: The Effect of Pituitary Extract,

Adienalm, and Insulm on the Ketonura produced in Rats by a Fat Det.—W Marshall The Preparation of Oxyha moglobin Crystals—X E Pitt The Influence of Ether Amesthesia upon the Gascons Composition of the Blood—E T Comphere, H B A R Densham, M. Marzels, and M S Peinbey Observations upon the Respiratory Exchange, Temperature, and Sugar in the Blood of Amesthetised Animals—A C Hampson and M Mariels The Permeability of Red Cells—R A Coller, H B A R Densham, and H M Wells The Reaction of the Skin Vessels in Manduring Over-Ventilation—Prof J Mellanby Petioleum Emulsion in the Small Intestine—Di monstrations—Dr W Clamer The Adienals of a Mouse with Exophthalmic Goite—Prof J Baieroft Some Observations on the Denervated Spleen Denervated Spleen

#### MONDAY, OCTOBER 17

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4—Prof P Bruynoghe The Twort-d'Herrelle Phenomenon, and some New Research on Relaying Fever (Hauben Lectures) Also on October 18 and 20 RALIWAY CLUB (25 Totbull Street, S W ), at 7 30—R G de Bray Outsign The Relayer Two Research Published Control of the Professional Control of the Published Control of the Pu

door Interlocking Apparatus
INSTITUTION OF THE RUBBIR INDUSTRY (Sales Section) (at Engineers' Club, Coventry Street, W.1)—II Hadley What Advertising Salesmanship can do for the Rubber Industry

#### TULSDAY, OCIOBER 18

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 4 -Sir William Hale-ROYAL COLLEGE OF LALLOWING WHITE HAIVEIGN (1241on ROYAL SOCIETY OF MEDICINE, at 5 30 —General Meeting.

White ' Haiveau Oiation
ROYAL SOLIATY or MEDICINE, at 5-30 — General Meeting.
ZOOLOGICAL SOCIETY OF LONDON, at 5-30 — Secretary ' Report on the
Additions to the Society's Menagerie during the mouths of June,
July, August, and September 1927 — C. II. Donald Some Indian
Birds of Prey — Dr. H. H. Scott. Double Mahgiant Tumoui of
Thyroid and Parathyroid in an Otter (Lutra lutha) — R. Essex Studies
in Repullan Degeneration — J. W. Low: Contributions to the Development of the Pelvic Girdle. II. The Pelvic Girdle in the Batrachian
Hymologia s. Ellepsoglossa nebulosa Dum et Bibr
ROYAL PROTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—F. F.
Renwick Presidential Address.
INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centie) (at
Engineering and Scientific Club, Wolverhampton), at 7-30.—Major E
G Beaumont The Influence of the Automobile User upon the Auto
mobile Engineer (Presidential Address).
INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39
Elmbank Crescent, Glasgow), at 7-30 — A. J. T. Taylor: The Industrial
Engineer. — W. S. Murphy: British Engineering Export Problems
ROYAL SOCIETY OF MEDICING (Pathology Section), at 8-30 — J. McIntosh.
The Histology of Some Virus Infections of the Central Nervous
System — Dr. R. J. Ludford The Repair of Superficial Skin Lessons
in the Mouse — Dr. W. Grame: Stomach Lessons in Rats kept on a
Diet Deficient in Vitanina A.

WEDNESDAY, October 19

#### WFDNFSDAY, OCTOBER 19

Society of Glass Technolory (in Applied Science Department, University, Sheffield), at 2:30 W. Butterworth, sen Presidential Introductory Address—J. F. Hyslop Opal Glass—Grystal Growth and Impact Brittleness. (A Communication from the Research Laboratories of the General Electric Co., Ltd., Wembley)—F. Buckley The Birmingham Glass Thade 17:0–18:33.—E. J. C. Bowmaker and J. D. Cauwood The Detection of Selenium in Decolourised Bottle Glasses. Glasses

Glasses
ELECTRICAL ASSOCIATION FOR WOMEN (at E.L.M.A. Lighting Service Bureau, 15 Savoy Street), at 3.—R. Borlase Matthews: Electricity and the Small Holding (Lecture)
ROYAL INSTITUTE OF PUBLIC HEALTH, at 4 — Prof. L. Cummins: Tuberculosis as a Social Disease.
EUGENICS SOCIETY (at Royal Society), at 5.30.—Dr R A Fisher: Multiple Births in Man.
NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (in Demonstration Room, Ground Floor, of Science Museum), at 5.30.—E. W Anderson: The Development of the Organ.
Society of Chemical Industry (Glasgow Section) (jointly with the Chemical Engineering Group) (at Ca'doro Restaurant, Glasgow), at 7—C. Scott Garrett and G.W. Riley. The Desiccation (De Vecchis) Process of Beet Sugar Manufacture
Electrical Association for Women (at E.L.M.A Lighting Service

of Beet Sugar Manufacture

ELECTRICAL ASSOCIATION FOR WOMEN (at E.L.M.A Lighting Service

Bureau, 15 Savoy Mireet), at 7—Mrs. L. Hollis and others: Discussion on A Demonstrator's Experience of Electric Cooking.

MERSEYSIDE AQUARIUM SOCIETY (at 1 Falkland Road, Egremont), at 7.30

—Annual General Meeting.

INSTITUTE OF CHEMISTRY, at 8—S. M. Gluckstein: Chemists and Dividends.

Dividends

Dividends

ENTONOLOGICAL SOCIETY OF LONDON, at 8

ROYAL MICROSCOPICAL SOCIETY, at S.—C. Beck: Note on Diatom Structure and Resolution.—Prof. H. G. Cannon and Dr. A. J. Grove: Aerating and Cinculating Apparatus for Aquaria and General Use.—Dr. A. J. Grove: A Simply Made Hot Plate for Flattening Parailin Sections.—Dr. O. Heimstadt. Stereoscopic Vision with the Microscope.—Prof. P. Vonwiller Microscopy with Incident Light and its Application to Living Objects.—D. P. Wilson Note on a Method of obtaining Long Working Distances with Low Power Objectives.

#### THURSDAY, OCTOBER 20

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6 ... Institution of Electrical Engineers, at 6 ... A. Page. Presidential Inaugural Address.

The Instruct of Metals (Birmingham Local Section) (Birmingham Metallurgical Society and Staffordshire Iron and Steel Institute) (at Bagineers' Club, Birmingham), at 7 — Dr. F. W. Aston. Isotopes. Instruction of Mechanical Engineers (North-Western Branch) (at Engineers' Club, Manchester), at 7.15.—R. E. Bailey: The Mechanical Testing of Materials.

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Chimical Society, at 8—Prof. T. M. Lowry and G. F. Smith: Studies of Dynamic Isomerism. Part XXIV. Neutral Salt Action in Mulaiotation—Prof. T. M. Lowry. Studies of Dynamic Isomerism. Part XXV The Mechanism of Citalysis by Acids, and Isases—Prof. C. S. Gibson and J. D. A. Johnson. 10 Chloro-5, 10 dilip drophena isazine and its Derivatives. Part V. The Goneial Method of Synthesis and Determination of Constitution—E. J. B. Willey. On Active Nitro, on Part IV. The Independence of the Afterglow and Chemical Properties of Active Nitrogen. of Active Nitrogen C B C Society in

Of Acouse Selections of Constructive Berth Control. and Richal Progress (at Essex Hall, Strand), at 8—Prof. J. S. Huxley. The Population Conference at Geneva (Lecture). Royal Solfty of Tropical Redicting and Hydrens (at 11 Chandos Steet, W.1), at 8.15—Prof. J. W. W. Stephens. The Functions of the Spleen (Presidential Inaugural Address).

#### FRIDAY, OCTOBER 21.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5-Sn Arthur Keith: Demonstration of Rheumanic and other Changes in Joints Institution of Mechanical Engineers, at 6-Sir Henry Fowler

Presidential Address
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Meeting Appeal of Pretonal Photography

Appear of Figure 1 Protography
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30 -- M
McCarthy Pring in General with Special Reference to the Vibro
Concrete Pring System.
RONAL SOCIETY OF MEDICINE (Electio-Therapeutics Section), at 8 30
Sir Henry Gauvan Electro-Therapeutics and the Future of Medicine
(Presidential Address), and short papers by Prof. Iselin, Dr. Dunham,
and Dr. Graveson.

and Di Glavesen
INSTITUTE OF CHEMISTRY (Manchester and District Section and Manchester Section of Society of Dyers and Colourists) (at Manchester).—
Prof E C C Baly Light and Lafe (Lecture)

#### SATURD IV, OCTOBER 22.

Institution of Municipal and County Engineers (Yorkshite District Meeting) (at the Mansion House, Doncaster), at 11 a.m.

#### PUBLIC LECTURES.

" SATURDAY, OCTOBER 15.

Horniman Museum (Forest Hill), at 3.30—Miss M. A. Muiray Egyptian Temples.

#### MONDAY. OCTOBER 17.

BRITISH MEDICAL ASSOCIATION (Hastings Hall), Taylsiock Square, at 5 15.—Dr. W. G. Savage: Food Poisoning (Malcolm Morris Memorial Lecture).

#### TUESDAY, October 18

University College, at 5. A. J. Hall: The Static Refleces of Magnus: How Animals get right-way-up and keep so.

#### WEDNESDAY, OCTOBER 19

KING'S COLLEGE, at 5 30 Dr. F. H. Spencer, The Public Elementary School

LONDON SCHOOL OF ECONOMICS, at 6. V. N. Gunness: Office Machinery. The Mignon Typograph and Cheque Protector

#### SATURDAY, OCTOBER 22.

HORNEMAN MUSEUM (Forest Hill), at 3.30. - Mis H. M. Dunn: The Peoples of India.

#### CONGRESSES.

OCTOBER 14 AND 15.

PUBLIC CONFERENCE ON FAMILY ALLOWANCES (at London School of Economics).

neconomics).

Friday, October 14, at 8.—Sir William Beveridge: The Case for Family Allowances.—Dr. R. A. Fisher: Effects of Family Allowances on Population.

Saturday, October 15, at 2.30.—Prof. V. H. Mottram: The Physiological Basis of the Minimum Wage.

At 3.30.—J. J. Cohen: Family Income Insurance.

At 5.30.—H. N. Brailsford: The State and Family Allowances.

At 8.—Principal J. Murray: Family Allowances in Industry.

Остовек 16 то 22,

Congress of Industrial Chemistry (at Paris).

OCTOBER 18 TO 23.

JORNADAS MÉDICAS DE MADRID (at Madrid),

Остовек 22 то 24.

CONGRESS OF THE ITALIAN SOCIETY OF LARYNGOLOGY, RHINOLOGY, AND OTOLOGY (at Parma).

Остовки 23 то 26.

ITALIAN CONGRESS FOR COMBATING TUBERCULOSIS (at Milan).

OCTOBER 24 TO 26,

ITALIAN CONGRESS OF INDUSTRIAL MEDICINE (at Parma, Moden Carpı).



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#### Science and Philosophy.

THE mild controversies which have been excited by Sir Arthur Keith's moderate and cautious presidential address to the British Association at Leeds suggest that science and scientific method are still regarded with some suspicion by the educated portion of the community. We need not take seriously the objections to the theory of evolution raised on sentimental or religious grounds m so far as these arise from prejudice and belief in authority Science can recognise no authority. and can admit no barrier to the free and fearless use of the intelligence The theory of evolution stands or falls on the "stubborn and irreducible facts" and upon the rational interpretation of them, and we need have no fear of the verdict of any impartial and competent jury, as Sir Arthur Keith has well and truly pointed out.

Another note has, however, been sounded by the wiser critics—a note not so much of antagonism as of doubt whether scientific method has, after all, proved an adequate key to the problems of the universe and of practical life. The Bishop of Ripon has voiced with great frankness this doubt of the adequacy of science. In hinting that the world could get on perfectly well if for ten years every physical and chemical laboratory were closed, he had in mind apparently two things—first, that the progress of science has vastly increased the complexity of man's material environment without improving his moral outlook or adding to his happiness, and second, that not only educated laymen but also specialists themselves are so overwhelme with the rush of new discoveries, new conception that they have no time to envisage the results a whole, to co-ordinate them and see them in the proper relation to other human activities. suggested in reference to the first point tha "patient and resourceful energy" displayed 1. laboratories could be turned to better effect were applied to the human and social proble the day, where clear and resolute thinkin much required. With this contention we propose to deal. Ne sutor supra crepid sound, if unheroic, maxim.

It is rather with the second point t<sup>1</sup> to come to grips, and particularly w gestion—emphasised also by several *Times*—that science is suffering fr philosophy, to its own detriment lessening of its influence on humar character. Dr. Burroughs, in the s to, asked whether amid all our ner

do not sometimes seem to have lost our sense of direction: "How many of our sectional explorers ever ask themselves which way lies the whole? Am I wrong in thinking that the several sciences increasingly feel the need of a philosophy to co-ordinate them?"

Twenty or thirty years ago, this suggestion that science might learn from philosophy would have been received with scorn in scientific circles. There was a spirit of confidence abroad, a conviction that the principles which had served so well and had led to such conquest over Nature were established beyond question, philosophy was branded as metaphysical and dealing in vain abstractions. We find an echo of this great period in Dr. Chalmers Mitchell's provocative and vigorous Huxley Lecture,1 where he roundly asserts that "philosophy, since she was judicially separated from science, although retaining the title 'lover of wisdom,' has made no positive addition to knowledge and has only been a spinner of vain words and barren ideas." This intransigent attitude is, we venture to think, rather unusual at the present day. The last twenty years have seen the foundations of physics torn up and rebuilt, and the change has come about not only by the press of new knowledge, but also to a great degree through keen hard thinking about the fundamental conceptions of the science, through true philosophical criticism, carried out by the physicists and mathematicians themselves. We can no longer rest content with the simple materialistic schema which atisfied Descartes and Laplace. As Prof. A. N. Thitehead writes in his remarkable book, "Science 'd the Modern World ":

The progress of science has now reached a ung point. The stable foundations of physics broken up. . . . The old foundations of tific thought are becoming unintelligible. space, matter, material, ether, electricity, anism, organism, configuration, structure, n, function, all require reinterpretation. is the sense of talking about a mechanical ation when you do not know what you mean hanics?"

r. Mitchell would have us cling tenaciously echanistic method in biology, on the only through its aid has come any ease of knowledge. This is not the liscuss in detail the merits and the fithe mechanistic method in biology; ver, remark à propos of Dr. Mitchell's is polemic against 'vitalism' mostly k, for the alternative to biological un Biology" Huxley Memorial Lecture, 1927. cmillan and Co, Ltd, 1927) 1s. net.

materialism is not necessarily a dualistic vitalism, but some form of organismal or emergent theory, all of which he confounds under the common ban

The mechanistic method, however, is itself an interpretation of Nature. It is, to use Dr. Mitchell own words about vitalism, "a proclamation of a belief and not an inference from observation" Its sole justification is the practical one, that it does up to a point help us to understand the activities of living things. But there are other methods of explanation possible, and it is unwise to rule them out as unscientific Since physics has found a revolution in its fundamental concepts' necessary, it seems dangerous for biology to cluig to the cast-off beliefs of the nineteenth century physicists. It must come to terms, too, with psychology, and give up the hopeless attempt to derive conscious behaviour from tropisms and conditioned reflexes, regarded as purely physical happenings

The time is indeed ripe for a critical revision of need not fear-that this biological concepts. by-ways. It is probable will lead us into mys that there will alwa 3 something left unexloubts the possibility of plained—even Dr. Mitc le—but clear thinking the part interpreting the bservation, but also, not only about the facts own methods of intermore important still, about und render managepretation, will help to rea able the mysteries of organ

· and evolution. Shall we call this criticism onceptions science or philosophy? This brings o the heart of the matter, and to our tentative relusion, which is "orce of science that the nineteenth century r side, and that from philosophy is good for ne co-operation should now be the der of the day. The benefit will be mutual Th. has been some justification for the jibe that losophy deals with words and abstractions, at is apt to be neglectful of the laboriously garn. d harvest of scientific fact. In the recent discer ies both in physical and in biological science, . re is ample material to keep the philosopher bu for years. The man of science for his part can arn much from the philosopher. He can learn 1 bossed and provisional his views of Nature may MON. difficult it is to get rid of irrational presupposit. which may colour all his thought

In his eloquent tribute to Huxley, Dr. Mitche points out that

"He accepted, as a postulate, but admitting it to be a postulate, belief in the rationality of the universe our minds seek to explore. This was the charter of science, conferring a certain right in return for the observance of certain duties. The right was that the writ of science should run whatsoever traditions, beliefs, dogmas, or customs it might destroy. The duties were accurate observation, clear statement, a logical scrutiny of generalisations so that they should not imply and should not seem to imply an iota of necessity, an open mind for new facts, but a cross-examination of the evidence for them the more ruthless in proportion to their apparent contradiction of widely based generalisations—and above all a profession of ignorance in preference to the propounding of acceptance of 'causal' principles which could not be put to the test of experiment."

That is well said, but it does not go far enough Let the clear thinking and the logical scrutiny be applied not merely to the generalisations resulting from observation and experiment but also to the underlying conceptions, the basal philosophies, in accordance with which these generalisations are formed. Let us scrutinise everything—even our most cherished scientific principles.

Coming back now to the broader question of the relation of science to other forms of human activity, we must recognise the limitations of scientific and indeed of any purely intellectual method. There are other aspects of human personality which science does not satisfy, and it would be foolish to extend the dominion of scientific method beyond its proper sphere. We do well to remember that the richness of reality is mexhaustible, both in its manifestation in the external world and in the depths and recesses of personality. Neither science nor philosophy can give more than an abstract and colourless rendering of essential truth, which is approached perhaps most nearly by creative But inside these necessary limitations the exercise of the intellect should be free, fearless, and untrammelled by any dogmatism, prejudice, or dependence on unrealised assumptions

#### Brewing and Malting.

A Standard Manual of Brewing and Malting and Laboratory Companion. Being a thoroughly revised and considerably augmented work, based on "A Handy Book for Brewers," by H. E. Wright, embracing the Conclusions of Modern Research. By John Ross-Mackenzie. Pp. xxiii+415. (London: Crosby Lockwood and Son, 1927) 45s. net.

AS a result of the great change which has taken place in recent times in the nature of the beer favoured by the public, the demands on the skill of the modern brewer are much more exacting than they were on that of his predecessor of a generation

ago. The brilliant and well-conditioned beer of to-day is characterised from the brewer's point of view by a low original-gravity, low alcohol-content, and low hop-rate. These factors, combined with the lack of nutrient matter in the modern wort, place a greater strain on the yeast, and also render the beer more liable to infection. On the other hand, modern scientific methods have provided a weapon with which to combat these difficulties. These are the influences traceable throughout the volume under review, and mark a stage in the passage of brewing from an art to a science.

The book appeared in its original form so far back as 1877, and was intended at that time essentially for the novice. In 1892 it was revised and enlarged under the title "A Handy Book for Brewers," but the author, H. E Wright, died at the time of the publication of the third edition in 1907. In the twenty years that have since elapsed the information has naturally become out-of-date, and the appearance of a revised and augmented work is to be welcomed. The plan and scope of the last edition has been followed fairly closely, though the student rather than the brewer is catered for

The first chapter sketches in outline the complete brewing process, and should prove useful to the beginner if studied in conjunction with the synoptic table at the end of the book, since the brewing operations are dealt with in order in more detail in the subsequent chapters. Brewing-room calculations, chemistry, hydrogen ion concentration and ferments in general provide additional chapters, and the book closes with a brief, elementary description of the brewery and its plant.

In a book which attempts to cover so vast a subject and its ramifications, in which the details of the methods used are largely matters of personal opinion based on experience, it is not difficult to pick out omissions and errors. On controversial points, however, the author has apparently endeavoured to strike a balance between opponents and to produce an argument that is not too bewildering for the beginner. This has involved the omission of a great deal of the most recent investigations on subjects such as starch, yeast, and the preservative powers of hops, though a readable account is given of the earlier work. Again, for example, reference might with advantage have been made to the vexed question of the Mariout barley, which in spite of its favourable analysis, appearance, and powers of resistance to extremes of climate, has been condemned in many quarters. The disposal of brewery by-products is also of sufficient economic importance to justify its inclusion.

The author is at his best when he deals with the varying conditions which influence the practical side of brewing His descriptions of chemical operations, however, are often lacking or out-ofdate. We doubt whether the student will be able to obtain the required degree of accuracy from many of the instructions with which he is provided, especially if his intelligence is assumed to be of such a level that he has to be told which end of the thermometer to insert in the drying-oven! A redeeming feature of the descriptions of the applications of science to brewing is the chapter on hydrogen ion concentration, the theory of which is outlined clearly by F A. Mason. Its usefulness, however, will be largely obviated by the fact that the practical applications of the theory occupy only half a page of this chapter, and nowhere else in the book are they mentioned This is a serious drawback when subjects such as mash-tun treatment, stability of beer, and the optimum conditions for enzymes are under discussion.

It is unfortunate that the book is characterised throughout by an extremely loose form of grammatical expression which at times renders the meaning almost unintelligible. Minor errors and misprints are far too numerous also, and the spelling of many words is rendered correctly in some parts and differently or incorrectly in others. names (Buchner, Marsh-Berzelius, etc.), and the title of Pasteur's classical work on beer, are among the more serious offences in this last respect. There is a lack of references to the original literature, and the frequent mention of a glossary which had to be omitted at the last moment is confusing There is also a paucity of illustrations, the few given being chiefly photographs of plant. The briefest description of the anatomy of the barley-corn, or of the hop, is incomplete without a diagram.

The book is well produced, but the advertisements, which have invaded even the end-papers and the backs of the title and contents pages, are an eyesore.

J. G.

### Plant Diseases.

Manual of Plant Diseases. By Dr. F. Deforest Heald. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xiii +891. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1927.) 35s. net.

THIS important book is the result of considerable experience in the teaching of plant pathology, which is now a recognised feature of No. 3025, Vol. 120]

agricultural and horticultural training The arrangement and treatment of the subject matter follows that adopted by Dugger in his well-known "Fungous Diseases of Plants," and has been used by the author in his classes during the last ten The book is divided into four sections, the first containing two chapters dealing respectively with the history of pathology and the symptoms of disease, the latter especially should be read by all students of the subject. Section 2 deals with non-parasitic diseases, caused by some unfavourable influence in the plant's environment. The effects of excess and deficiency of available nitrogen and potash in the soil are discussed at length, and examples are drawn from 'sand drown' of tobacco, 'yellow berry' of wheat, and 'potash hunger' of potatoes and tobacco. It is perhaps unfortunate that the important problem of 'leaf seorch' of orchard trees finds no place in the discussion. A considerable amount of useful information is given in other chapters setting out the effects of unfavourable air, light, temperature, and water conditions upon plant growth. 'Bitter pit' and 'scald' of apples are excellent examples of the treatment given to individual disorders.

The phenomenon of photoperiodism, which has attracted much recent attention, is briefly described in three pages. One may perhaps doubt the advisability of including it in such a book, where space is valuable, but if it is worth discussing at all in relation to plant disease, these pages seemquite inadequate for the purpose.

In dealing with diseases proper, the author has selected those which are of economic importance, and has described the history, distribution, symptoms, etiology, host relations, and control of each, together with a list of references at the end of each disease and a brief note of etiologically related diseases at the end of each chapter. The lists of references to literature are extensive, but they are mainly concerned with American investigations. Reference to foreign papers seems desirable.

Section 3 is devoted to virus and related diseases. Only those who have struggled with the mass of literature on this subject can appreciate Dr. Heald's difficulty in compiling a reasoned account of these fascinating diseases. He has succeeded in giving the elementary student an insight into the subject, which should stimulate his interest and appreciation of its importance.

Section 4 occupies two-thirds of the book, and is devoted to parasitic diseases, including those caused by bacterial pathogens, which are classified

in accordance with Migula's scheme. Actinomyces scabies is, however, included among the bacteria Fungus diseases are treated admirably, with good arrangement and up-to-date material. Students should have little difficulty in obtaining a good working knowledge of plant diseases. The section ends with a discussion of diseases caused by parasitic seed plants and nematodes, but the latter chapter does bare credit to the importance of these animal pests. Investigators have the greatest difficulty in distinguishing between parasitic and non-parasitic forms present in diseased material, and many harmless forms have been convicted of evil intent without proper trial. Students should be warned against this.

A good general index is provided, but there is no host index. The volume is well illustrated, and the illustrations are usually effective, but Figs 199-202 are decidedly poor and are not calculated to inspire the student.

The object of teaching plant pathology is to train workers to diagnose and control diseases which are causing serious damage to economic plants the world over. This being so, an effective text-book must include a clear account of the physiology of disease and the principles of disease control. It is regrettable that Dr. Heald has purposely omitted this part of the teaching of pathology from his text-book, which will doubtless be used by many teachers of the subject.

W. F B.

# A New Version of the 'Intellect.'

The Measurement of Intelligence By Edward L. Thorndike, E. O. Bregman, M. V. Cobb, Ella Woodyard, and the Staff of the Division of Psychology of the Institute of Educational Research of Teachers' College, Columbia University. Pp xxvi+616 (New York: Teachers' College, Columbia University, n.d.) n.p.

MANY circumstances invest the present volume with signal importance. Of such an unusual magnitude has been deemed the investigation which it reports, that a special grant was assigned to it by the Carnegie Corporation, and for the last four years Thorndike has so devoted himself to it, as even to give up for its sake his university teaching. Moreover, as indicated above, his entire staff has been collaborating with him.

The account of all this work begins by freely conceding that hitherto mental tests of the intellect have been afflicted with "three fundamental defects": ignorance of what is being tested;

ignorance of how the test-scores should be combined, and ignorance of what the results signify in respect of the intellect

To cope with this situation, the authors in the first place conceive the intellect as having two dimensions: on one hand "altitude", on the other, "width." By the former they mean "the degree of difficulty at which a person can succeed at tasks", by the latter, "the number of tasks that he can succeed with at any specified degree of difficulty."

So far, all is plain sailing enough. But now have to be encountered the "fundamental defects." For these concepts of altitude and width of intellect can serve no useful purpose until we settle what kinds of mental performance the word 'intellect' is really intended to comprise. On this vital point the authors commence in a surprising fashion.

"For a first approximation, let intellect be defined as that quality of mind (or brain, behavior, if one prefers) in respect to which Aristotle, Plato, Thucydides, and the like, differed most from Athenian idiots of their day."

How the mental make-up of these idiots shall ever be ascertained is left unsaid.

Later on, however, a more definite view is advanced and made the actual basis of the present investigation. It is to the effect that every one can take intellect to mean whatever he will.

"What abilities and tasks shall be treated as intellectual is essentially a matter of arbitrary assumption or choice at the outset. . . . After the first choice is made, tasks not included in it, and not even known, may be found to correlate perfectly with the adopted total, and so to be intellectual"

The authors themselves select as their "first choice" what they call "intellect CAVD," composed as follows.

- $\lq\lq$  C. To supply words so as to make a statement true and sensible.
  - "A. To solve arithmetical problems.
  - "V. To understand single words.
- "D. To understand connected discourse, as in oral directions or paragraph reading."

To the study of this "intellect CAVD," then, the whole investigation is really directed, and a very remarkable result is the outcome. Evidence is adduced that these four abilities, C, A, V, and D, jointly constitute one single "total-ability," in the sense of a "unified, coherent, fundamental fact in the world."

With great interest the reader turns to examine upon what sort of evidence such a result has been founded. It consists in the discovery that the different "altitudes" of the intellect CAVD correlate with one another to a degree which—on due correction for attenuation by random disturbances—is little if at all short of perfect unity. This line of evidence in respect of the originally adopted intellect CAVD is just the same, it will be noticed, as that which our previous quotation gives for making any subsequent additions to the purview.

Now comes a curious point which the authors appear to have overlooked. It is that this kind of evidence—perfect correlations after being corrected for attenuation—is precisely that which was introduced by the present reviewer in first demonstrating the existence of what our school calls g. Even the various criteria used afterwards for this purpose (including the latest, that of 'tetrad differences') are merely diversified mathematical forms of expressing exactly the same thing. (For proof of this statement, reference may be made to the reviewer's recent work, "The Abilities of Man.")

It only remains, then, for Thorndike to carry out his programme and ascertain what further abilities correlate perfectly with his initial CAVD, when the correction for attenuation is effected in a suitable manner. Assuredly he will find, just as we have done in the book just referred to, that the range includes all abilities whatever—In this way his "unified, coherent, fundamental fact in the world" turns out to be our g once again, nothing more or less.

Hereby is completed the entire chain by which, link after link, the school of Thorndike has been gradually adopting all the chief doctrines long advocated by ourselves. In such an eventful convergence of originally warring views, we may venture to see a most hopeful augury for the future of psychology as a positive science

C. Spearman

# Tycho Brahe.

Tychonis Brahe Dani: Opera Omnia. Edidit I. L. E. Dreyer. Tomus 8. Pp. 471. n.p. Tomus 12. Pp. iv+488. n p. Tomus 13. Pp. iv+398. n.p. (Hauniæ: Libraria Gyldendaliana, 1925–1926.)

THE eighth volume of this monumental edition has the melancholy distinction of being the last that was published in the editor's lifetime. It shows no diminution of the accuracy which always distinguished Dr. Dreyer's work. The editor calls it the third volume of the "Epistolae Astronomicae," a series which is here continued

from June 1597 to June 1601, four months before Tycho's death.

The plan of this volume is the same as that of the second volume of the "Epistolae," the seventh of the whole series, but the subject matter is largely different. While the second volume was mainly occupied by letters written while Tycho was steadily pursuing his observations at Hveen, supported by liberal emoluments and aided by numerous assistants and workmen, in this volume he is a traveller, seeking a new home in which to continue his work. We find him first at Rostock, then at Wandsbeck, afterwards at Benatky, and finally at Prague; and it is natural that his correspondence should be largely concerned with negotiations for reconcultation with his former patron the Danish king, or with the view of securing a new patron, such as he eventually found in the We have also the corre-Emperor Rudolf II. spondence relating to the equipment of the observatory at Benatky.

For the life of Tycho, these letters are most interesting. They have the further interest that they introduce us to Kepler, whose first letter to Tycho, accompanying a copy of his "Mysterium Cosmographicum," begins on p-14 of the volume, and whose last letter in October 1600 ends on p. 385. As the connexion thus established with Kepler was the most important, it might be said the only valuable result of Tycho's removal from Denmark, and as it resulted in the discovery of the laws of planetary motion, it is very gratifying to find this correspondence set in its place among Tycho's astronomical letters

The most interesting letters in this correspondence are perhaps Tycho's critique of the "Mysterium Cosmographicum" and the testimonial which Tycho gave Kepler in June 1600. Both have been published among the collected works of Kepler and are well known to students of the history of astronomy. In the former letter (pp. 44-46), Tycho, in the most courteous way. cast doubt on Kepler's theory of the connexion between the planetary spheres and the five regular solids, because it rested on Copernicus's values for the distances and eccentricities, which were seriously in error. He also objected to any doctrine of 'orbium realitas,' that is, to any reality of the spheres, and regarded the immense distance to which the Copernican hypothesis relegated the socalled eighth sphere, the sphere of the fixed stars. as an absurdity which by itself would destroy the whole theory. He suggested that Kepler should continue his line of study, including the eighth

sphere in his harmony, and invited his co-operation. In the same letter Tycho declared that the reason for his removal from Denmark was to prevent the destruction of his astronomical treasury collected through so many years with such great labour and expense. With our great store of observations it is difficult to realise the uniqueness of Tycho's work, so far exceeding anything that had survived from the ancient or that seemed likely to be attempted again in the modern world.

The editor, in addition to his usual brief but pertinent comments, has in this volume given us an alphabetical biographical index of the principal people named in the astronomical letters.

The twelfth and thirteenth volumes complete the collection of Tycho's observations. A flysheet issued with the last of these and dated 1926, Sept. 25, records how Dr. Dreyer before his death on Sept. 14 had requested the presidents of the Society of Danish Language and Letters to present this last volume of Tycho Brahe's treasury of observations to the Carlsberg Institute on Sept. 25, the fiftieth anniversary of its foundation, in gratitude for the munificence with which it had provided for the publication of the greater part of the works of the famous Danish astronomer.

The two volumes of observations contain not only Tycho's observations, but also several by Fabricius, and a few collected by Kepler There are also two catalogues of stars, but Tycho's complete catalogue appears elsewhere. Probably the most important part for present-day astronomy is to be found in the 107 pages devoted to observations of seven comets. These observations at least can never be superseded by observations of other comets made with better instruments.

J. K F.

### Our Bookshelf.

Artificial Fertilisers: their Chemistry, Manufacture and Application. By P. Parrish and A. Ogilvie. Vol 1 Pp. 356. (London . Ernest Benn, Ltd , 1927.) 45s. net.

As the authors state in their preface, this is the first English treatise on artificial fertilisers which deals in any detail with the technique of the manufacture of fertilisers. This, the first of two volumes, is almost entirely devoted to the manufacture of phosphatic manures, and the mixing and compounding of these with other fertiliser ingredients. After surveying in some detail the world's resources of phosphatic material, the mining operations are described in some detail.

The bulk of the book is taken up with the manufacture of superphosphate, by-products of other industries such as basic slag taking quite logically a minor share. Superphosphate manufacture in its

main outline has not changed since its invention, and improvements are due rather to engineering than to chemical progress, and modern plant and machinery are described and well illustrated by diagrams and photographs. The chemistry of the manufacture of soluble phosphates is dealt with briefly but adequately for the needs of the technician, although the statement on p. 31 that "phosphate rock is essentially tricalcium phosphate" is misleading and is contradicted later in the book. The chemistry of open-hearth basic slag is still obscure, but enough is said to indicate the problems before the investigator. A correct interpretation is given of the results in the citric solubility test for water-insoluble phosphate and, up to the present, no better measure of the availability of phosphate to the plant has been discovered.

This work comes at an opportune moment: the old-fashioned fertiliser industry in Great Britain has not only to face foreign competition in the export trade, but also attractive new compounds now being placed on the market by the great German fertiliser firms. In these, phosphoric acid functions as a carrier of ammonia and sometimes of potash also The superphosphate manufacturers of Great Britain are fully alive to this new aspect and the formation of the International Superphosphate Association is the result In a stimulating and thoughtful final chapter the trend of future developments is discussed. The authors conclude that superphosphate will be required for many years to come, but that only larger factories operating with highly efficient plant will be able to compete at all successfully.

Such a readable and well-illustrated book cannot fail to be of interest and service to all connected with the fertiliser trade, and the second volume will be awaited with interest.

The Practical Telephone Handbook and Gurde to the Telephonic Exchange. By Joseph Poole, and others Seventh edition, thoroughly revised and enlarged. Pp. xxv+870. (London: Sir Isaac Pitman and Sons, Ltd., 1927.) 18s. net

DURING the last few years the art of telephony has made gigantic strides and the future of the telephone industry seems very promising. Many engineers first acquired their working knowledge of the subject from the earlier editions of this wellknown handbook It has gradually increased in size, although much obsolete and obsolescent matter has been cut out in each edition In this latest edition the book has been increased by 146 pages and more than 100 illustrations. Although the book is becoming more technical and more mathematical, it can still be recommended for the beginner. The rapid progress of automatic telephony in Great Britain has taken even experts by surprise A few years ago it used to be urged that its secrecy, which is really one of its greatest advantages, laid it open to the practical joker who could play silly tricks with impunity. In the United States the trouble had proved to be a real one, and special laws were proposed to frighten the jokers. An unscrupulous business man also might cause the line of a rival to test 'engaged' at important times of the day. Luckily these defects have

been completely remedied

To scientific men the use that telephonists make of 'phantom circuits' to increase the number of conversations that can take place simultaneously between two stations always seems wonderful. The authoritative account of trans-Atlantic telephony given in this book will prove helpful to many. The saving of costs of trunk lines by means of thermionic valve repeaters is shown by the fact that in place of aerial lines weighing from 100 lb to 800 lb. per mile, there are now underground cables working between London and Glasgow and between London and Berlin weighing only about 20 lb per mile.

Linienspektren und periodisches System der Elemente. Von Dr. Friedrich Hund (Struktur der Materie in Einzeldarstellungen, herausgegeben von M. Born und J. Franck, Band 4.) Pp v1+ 221. (Berlin: Julius Springer, 1927.) 15 gold marks.

SINCE the work of Bohr, followed by that of Sommerfeld, Catalán, Heisenberg, and others, gave a theoretical foundation to spectroscopy, the analysis of the spectra of the elements on the basis of quantum mechanics has proceeded apace. The results are scattered through many journals, in many tongues. This material the author has collected and welded into a coherent account. The appropriate results of quantum analysis are quoted and their significance explained without the burden of mathematical proof The application of these results to the line spectra of the elements of the different columns of the Periodic Table is then fully discussed. Practical spectroscopists, chemists, and (may we whisper it) students of physics who wish to learn something of the methods and results of the new spectrum analysis, without first undertaking the formidable task of learning quantum mechanics, will welcome this well-written and informative account. For those who may wish to pursue the subject further, either on its more theoretical or on its experimental side, the author supplies a full and well-arranged bibliography of the literature of the subject, to the end of the year 1926.

Thermodynamics and Chemistry. By Prof. F. H. Macdougall. Second edition. Pp vii + 414. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd, 1926.) 27s. 6d. net.

The first edition of Prof. Macdougall's book was well received, and in the new edition the author has incorporated a considerable amount of new matter and has revised the old so that the work is considerably improved. The treatment is straightforward, with a free use of the calculus. The rather long section on phase rule diagrams is out of place, since there are separate text-books giving a better and more detailed treatment of this branch of the subject, which is more a matter for the drawing office than for the student of thermodynamics. The properties of electrolytes are dealt

with from the point of view of activity, and the Debye equation is used, although its detailed deduction is omitted. A good feature is the melusion of problems, but these are omitted in the last chapter on the quantum theory and Nernst's heat theorem. The number of books on chemical thermodynamics is not large, and Prof. Macdougall's is a useful member of the group. The only unsatisfactory feature of the book is its price, which is excessive, although that of the first edition was even higher.

South America an Economic and Regional Geography, with an Historical Chapter. By Dr E W Shanahan (Methuen's Geographical Series) Pp xiv + 318 (London: Methuen and Co., Ltd., 1927.) 14s. net.

DR SHANAHAN has succeeded in producing a book on South America that was much needed. After some preliminary chapters on the continent as a whole, including a most interesting one on historical geography, he treats South America by natural regions, thus avoiding much repetition which a

treatment by States would entail.

The book bears evidence of wide and discriminating reading, but it gives the impression of a compilation and lacks signs of personal acquaintance with South America Many of the broader human interests receive little notice, such as the immigration problems, the racial problems, and the character and peculiarities of the great cities and scaports. Cities are not merely market places; they have individualistics that are worthy of portraval even in a geographical work, if geography is to escape the charge of being merely the background of commerce But in spite of these criticisms we welcome the book, especially for its freedom from bias towards any particular interest or State, a defect which mars too many works on South America

An Introduction to Building Science By F. L. Brady. Pp. vni + 280 (London: Edward Arnold and Co., 1927.) 78 6d. net.

In a series of twenty-five chapters the author discusses his subject under the headings of physics and chemistry. His method is perspicuous and the diagrams deserve appreciative notice, as also the series of experiments and the lists of questions at the end of the successive chapters. They serve the useful purpose of testing the degree of know-

ledge acquired from the previous pages.

The use of constants for conversion from one thermometric scale to another is most unnecessarily condemned by Mr. Brady. He is, of course, not responsible for the double significance of the word calorie (distinguishable only by the employment of upper or lower case initial), but such duplication is unfortunate. If it be granted that "alloys are mixtures of metals," why call steel an alloy? It is no more an alloy than is wrought or cast iron, all three being dependent upon the proportion of contained carbon. Fig. 37 would be better were the comparative diagrams drawn to one scale. The book is, however, one to be accorded a hearty welcome.

# Letters to the Editor.

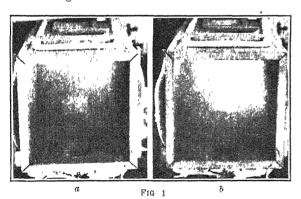
[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. No notice is taken of anonymous communications.]

# The Magneto-optical Effect and a Correction.

This communication concerns the magneto-optical effect, described by me in Science (N.S. vol. 53, No. 1382, pp 565 to 569, June 24, 1921) and Nature, June 23, 1921, p 520, which was at that time a novel discovery or observation. The description was later followed by a statement of "Further Investigations" (Science, N.S. vol. 54, No. 1387, pp. 84-85, July 29, 1921)

In the first place I desire to make a correction in the latter communications, where it is stated that the "flickering observed appears to keep time with the cycles and not with the alternations of current." This is an error, as it was found later that the described fluctuations do follow the alternations, the mistake being due to misinformation as to the cyclic rate.

It may be desirable here to describe briefly the original phenomena, adding comments which relate to more recently observed facts. A magnetic field produced by a direct current, permanent magnet, or by interruptions or alternations of current, is rendered visible even when very weak, by a light smoke from an iron arc; such fume or smoke being effective for the purpose even when so thin or diffused as to be scarcely noticeable in the air Such smoke, diffused in the space where a field exists, when illuminated from above by sunlight or an artificial source and viewed in a direction across the light beam and more or less normal to the direction of the lines of force of the field, apparently becomes luminous, but in reality becomes a far better reflector diffuser in certain directions of the incident light than when the field lines are absent.



Viewed along the magnetic lines, no increased luminosity is produced even when the field is strong or the illumination strong, or both.

The condition for its observations seem to be.

(1) Illumination transverse (more or less) to the direction of the lines of the field.

(2) Viewing in a direction more or less transverse to the lines of the field and to the direction of the incident light

The amount of iron smoke in the air required to produce a very noticeable effect seems to be very small, although density of the smoke increases greatly the contrast between what is visible when current or field is on, and when no field exists. Indeed, without the presence of the field the smoke from the iron arc may be practically invisible. The illumination from

the smoke particles was found to be polarised as if produced by reflection from strings of fine particles, oriented in the direction of the field lines. These particles are exceedingly small, almost beyond ordinary high powers of the inicroscope, and the striated feiric oxide, which it seems to be, can be caught on a microscope slide while the magnetic field is on, and studied under high powers.

The remarkable thing is the small amount of the iron smoke needed to produce the effect and the instantaneous response to very weak fields. Thus, if an open coil or helix without a core of non be traversed.

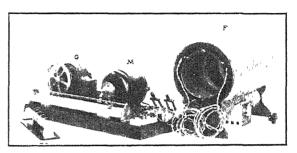


FIG. 2.

by a fluctuating or slowly alternating current, the flickering may be shown by a detector constituted by holding the open neck of a glass flask over an iron are for a few moments. Some of the smoke enters the flask, which can then be corked. Such a flask has shown flickering at a distance of twelve feet away from the small coil, through which a low frequency current was sent; and, curiously, when the flask was placed near the coil, the flickering was replaced by a steady illumination. When gradually removed from the coil in the direction of its axis, the flickering became more and more pronounced.

This indicates that the orientation, or arrangement of the particles to correspond with the field lines, takes place with a weak field, and almost instantaneously in a strong alternating field, in the latter case being accomplished and maintained throughout the whole wave of current. The zeros seem to be without effect in arresting the appearance, while at a considerable distance away from the same coil, excited as before, the weaker field at such a distance can only orient the particles at or near the maxima of the current waves. This seems to indicate that a certain very low value of the magnetising force is sufficient for the orientation or alignment of the particles. Retention of vision by the eye may also cover up any very short interruptions in the luminous effect itself.

Use has been made since the publication of the original descriptions of the effect for rendering visible to the eye a rotating field produced by biphase, three-phase, or polyphase currents. The effect is unique, and it can be photographed.

In the accompanying illustrations, Fig. 1,  $\alpha$ , shows a box with a glass front and back, a beam of light being sent in from the back with no excitation or magnetic field present; Fig. 1, b, shows the same with the coil lying flat on the top conveying current. In this case it is clear that a luminous effect, displaying the field of the coil has been depicted. In each case, of course, iron arc smoke has been within the box at each trial; it being allowed to enter through a hole at the bottom of the box seen indistinctly in the figures. It is surprising, too, how long a time it takes for the fumes to settle out of the air within the apparatus.

In Fig. 2 is shown a device for rendering visible a rotating field, such as that of a three-phase motor. The structure at F is, in fact, a field winding, clearly

showing in the photograph the three entering wires for its excitation. As the ordinary frequencies would be too high for observation, the rest of the figure to the left shows a small motor M driving at reduced speed a small generator G of the three-phase currents needed for the excitation of the field at F. Usual arrangements are provided for varying the speeds, and thus the cyclic rate or frequency of the currents in F. The interior of F is arranged with glass ends so that it may receive illumination from the back, and also that it may receive and retain iron arc smoke. In this way the revolving field inside the structure F becomes distinctly visible by a luminous glow revolving within it.

The direction of revolution may also be instantly changed by the switches provided for reversing two of the phases, and the speed of revolution of the field may be made slow, or so fast that retention of vision

results in a continued interior luminosity

It is probable that with further development, such arrangements may be designed to make use of this magneto-optical phenomenon in the study of distortions in alternating fields by the introduction of closed circuits in the form of rings, plates, and various forms of conductors, or even to compare the distortions produced by the material as well as the form of conductors in alternating fields. Perhaps, also, the distortions of field lines produced by revolving or moving conductors in even direct current fields may be exhibited or investigated. My time has not permitted much work, interesting as it may be, to be carried on.

Elihu Thomson.

July 5.

## The Origin of the Nebulium Spectrum.

In his letter to Nature of Oct. 1, p. 473. Mr. I. S. Bowen has made the important suggestion that several of the chief lines in the spectra of gaseous nebulæ may be due to what spectroscopists have called 'forbidden combinations of terms in the spectra of ionised nitrogen (NII), ionised oxygen (OII), and doublyionised oxygen (O III). It is, of course, no longer permissible to suppose the existence of hypothetical elements to account for the long-standing mysteries of nebular spectra, and we must accordingly regard the nebular lines as being produced by known elements under conditions of excitation which have not yet been imitated in the laboratory. It has seemed natural enough to look to the lighter elements, and those who, like myself, have given special attention to the spectra of these elements under widely varied conditions, have doubtless kept in view the possibility of finding some indications of nebular lines in the course of their observations. Extensive experiments, however, have failed to reveal any traces of them.

The evidence put forward by Mr. Bowen in favour of ionised oxygen and nitrogen is already very substantial and demands careful consideration. The case for O III is, in fact, a good deal stronger than appears from his letter. I have lately been investigating the structure of this spectrum, and it may be of interest to refer to some of the results obtained.

Doubly-ionised oxygen has six external electrons, and some of the more important configurations (in  $n_{\star}$  orbits), with the corresponding types of terms predicted by Hund's theory, are shown in the following table, the notation being that adopted in a recent paper on N II (*Proc. Roy. Soc.*, A, vol. 114, p. 662).

1.	2, 2,	3, 3, 3,		Terms
2 2 2	2 2 2 1 2 1 2 1	1 1 1	$\begin{array}{c} s^2p^2 \\ s^2p \cdot s \\ s^2p \cdot p \\ s^2p \cdot d \end{array}$	$\begin{array}{c} 1^{3}P_{210} \ 1^{1}D'_{2} \ 1^{1}S'_{9} \\ 1^{3}P'_{210} \ 1^{1}P'_{1} \\ 1^{3}D'_{321} \ 2^{3}P_{210} \ 1^{3}S'_{1} \ 2^{1}D'_{2} \ 1^{1}P'_{1} \ 2^{1}S'_{0} \\ 1^{3}F'_{432} \ 1^{3}D_{221} \ 1^{2}P''_{120} \ 1^{1}F'_{3} \ 1^{1}D_{2} \ 1^{1}P''_{11} \end{array}$

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Without reference to the nebular lines, I have determined all of the terms on the second, third, and tourth rows, besides others, from my own (unpublished) observations. Utilising Bowen's observations in the extreme ultra-violet, the values of the three deepest terms follow as a matter of course, but are less accurate in consequence of the difficulties of measurement in this part of the spectrum. For the  $1^3P$  terms, Bowen has found  $1^3P_2 - 1^3P_1 - 193$ ,  $1^3P_1 - 1^3P_0 - 116$ , and the two green nebular lines are attributed by him to O III because of their separation  $\Delta r - 193$ . He thus identifies the nebular lines with the forbidden combinations  $1^3P_2 - 1^3D'_2$  and  $1^3P_1 - 1^3D'_2$ , but, the value of  $1^3D'_2$  being then undetermined, he gives no additional evidence in support of this view.

From singlet combinations in the extreme ultraviolet previously suggested by Bowen (*Phys. Rev.*, vol. 29, p. 241), in combination with the values of  ${}^{1}P_{1}'$  and  ${}^{1}P'''$  since determined by myself, it is readily found that  ${}^{1}D'_{2}$  - 424385, and  ${}^{1}S'_{0}$  = 401472. For the nebular lines, on Bowen's view, we thus have

The assumption as to the nebular origins in question can be tested by the lines  $\lambda 305.7$  and  $\lambda 374.3$  previously suggested by Bowen as probably representing the regular combinations  $1^3P - 1^3P$  and  $1^3P - 1^3P'$  respectively, using the values for  $1^3D$  and  $1^3P'$  which I have determined. Unfortunately, each of these combinations yields six components, which cover but 0.29 Å in the first multiplet and 0.36 Å in the second, and so have not been resolved. However, the calculated wave-numbers for  $1^3P - 1^3D$  range from 326986 to 327295, and compare very favourably with the observed line  $\lambda 305.7$ , for which  $\nu = 327118$ . Similarly, the lines  $1^3P - 1^3P'''$  range from 267134 to 267584, and are in good agreement with 267165 representing the observed line  $\lambda 374.3$ . These considerations appear to give strong support to the view that the two green lines of the nebulae are due to O III, but no further tests appear to be available at present.

The agreement in position of the nebular line  $\lambda 4363.21$  with the combination  $1^4S'_0 - 1^4D'_2$  of O III is as close as can be expected, and further tests would seem to depend upon the possibility of measurements of lines in the extreme ultra-violet and in nebulae with a still higher order of accuracy.

The evidence for attributing the nebular lines λ6583 6, λ6584·1 to N II appears to be very convincing, but the published observations of the N II spectrum in the extreme ultra-violet are inadequate

to provide further tests.

Bowen's assignment of the strong nebular lines  $\lambda 3728.91$ ,  $\lambda 3726.16$  to O II leads to term values for  $1^2D_{32}$  of the expected order of magnitude, and the consequent calculation of the red line  $\lambda 7325$  may be provisionally considered to support the suggested identifications. Owing to the apparent absence of regular intercombinations of doublet and quartet terms, however, the only test at present available would seem to be the discovery of one or more companions to the nebular line  $\lambda 7325$ . If the identifications be correct, there should be a satellite about 10 A distant on the less refrangible side of this line, and a 'second chief' line in a position which cannot be predicted because the separation of the  ${}^2P'_2$  terms has not yet been determined.

The numerical evidence, on the whole, thus appears to be in favour of Mr. Bowen's suggestions, and it is interesting to note that if these should be fully

confirmed, the observations of nebulæ may be used to determine the structure and exact positions of certain unresolved lines in the extreme ultra-violet

A FOWLER

Imperial College of Science, South Kensington, S.W.7, Oct. 14.

#### The Rare Earths.

In searching for evidence that would enable a decision to be made as to the exact distribution of the electrons responsible for the series of fifteen 'rare earth' elements from lanthanum to lutecium, the colour of their salts appears to be of prime importance, particularly as it is known that colour is intimately associated with movements of electrons in atoms. The fact that many of the rare earths yield coloured salts has led to considerable uncertainty as to their proper place in the periodic classification, and many attempts have been made to allocate them to appropriate periodic groups on the grounds of valency, isomorphism, and colour analogies.

I have recently shown (Jour. Chem Soc., Sept. 1927) that the foregoing fifteen rare earth elements are all analogues of scandium, the last fourteen of them forming an anomalous subseries of the transition subperiod of the third long period of the classification. This arrangement rules out any possibility of allocating these elements to more than one periodic group. It follows, in consequence, that the rare earths have no real relation to any other series of elements and that the observed colour resemblances are fortuitous.

Examination of the colours of the salts of these elements from this new viewpoint has brought to light colour sequences hitherto unrecognised, the sequence of colours of the salts of the first eight rare earths being identical with that of the last eight in reverse order. Lanthanum, cerium, praseodymium, needymium, illinium, samarium, europium, and gadolinium salts are colourless, colourless, green, red, unknown, yellow, faint rose, and colourless respectively, while those of lutecium, ytterbium, thulium, erbium, holmium, dysprosium, terbium, and gadolinium show the same colour sequence, with the apparent exceptions of terbium and holmium.

The salts of terbium, the 7th member of the 2nd series, are recorded as colourless, but in thick layers they are almost certainly faintly rose, for they exhibit absorption at the blue end of the spectrum. Terbium is thus analogous to europium, the 7th member of the 1st series, the salts of which are either faintly rose or colourless and exhibit absorption mainly at the blue end of the spectrum.

The salts of holmium, the 5th member of the 2nd series, are known to be yellow, whereas the salts of the recently discovered element illinium, the 5th member of the 1st series, are as yet unknown. From the duplicate colour sequence, however, it may be predicted with confidence that illinium salts when obtained will be yellow like those of holmium. The yellow colour predicted for illinium salts may partly explain why illinium was not sooner detected in the intensive researches on rare earth separations of the last century, for samarium, with which it is naturally associated, is nearest in atomic weight, yields yellow salts, and probably exhibits absorption in the same spectral region.

As the duplicate colour sequence shown in the following table relates to the trivalent ions of the elements, the numbers in the 1st column are the

actual numbers of electrons in the ions (3 less than the atomic numbers)

51 La,	68 Lu	colourless	0,	14	0		(0, 0),	(6, 8)
55 Ce,	67 Yb	,,	1,	13	+1,	-1	(1, 0),	(6, 7)
56 Pr.	66 Tm	green	2,	12	+2,	-2	(2, 0),	(6, 6)
57 Nd.	65 E1	red	3,	11	+3,	- 3	(3, 0),	(6, 5)
58 11,	64 Ho	yellow	4,	10	+4,	4	(4, 0),	(6, 4)
59 Sa.	63 Dy	,,	5,	9	+5	- 5	(5, 0),	(6, 3)
60 Eu,	62 Tb	faint rose	6,	8	+6,	- 6	(6, 0),	(6, 2)
61.6	h£	colourless	1 1	7	+	7	(6.	1)

In the 3rd column are shown the numbers of electrons in the ions after deducting the 54 of the La ion (xenon structure). The 4th column shows the variation of these electrons from 0 and 14, cerium for example having 1 electron and ytterbium -1 (1 less than 14). The identity in the colour sequences indicates that the same colour is obtained in two different ions when one has as many electrons more than zero as the other has less than 14.

There being only two colour sequences, it may be regarded as certain that the 14 electrons concerned are arranged in only two sets or subgroups. Further, as gadolimium is the only element common to both sequences, being the last of the first sequence and the first of the reversed sequence, it may be inferred not only that gadolimium has electrons in both subgroups, but also that the second subgroup begins when the first is complete. As gadolimium has 7 electrons and lutecium 14, it follows that the former has the subgroup structure 6, 1, and the latter 6, 8. The complete distribution of the 14 electrons in the rare earth elements is given in the last column of the table.

It can be no more than a curious coincidence that the number of electrons in each ion from gadolinium to lutecium is expressed by the same figures as the numbers of electrons in the two subgroups, the gadolinium ion, for example, having 61 electrons and the subgroup structure 6, I.

In Bohr's theory of atomic structure, the maximum number of subgroups in a quantum level is equal to the quantum number, and the maximum number of electrons in a subgroup is equal to twice the quantum number. In the 4-quanta level there should thus be 4 subgroups of 8 electrons each, this structure being attained in lutecium by the increase of 3 subgroups of 6 each to 4 of 8 each, thus involving four types of subgroup change though only two types of change are evident from the duplicate colour sequence.

Early in 1924 I pointed out that the experimental facts of emission and absorption X-ray spectra indicated a number of quantum subgroups invariably greater than is given by Bohr's rule. The intensities of the emission lines and the widths of the absorption bands further indicated that the numbers of electrons in subgroups could not be equal, evident also from the fact that the number of subgroups in a level is always an odd number, while the total number of electrons m a level is always an even number. I deduced that the 4-quanta level must contain 7 subgroups of 2, 2, 4, 4, 6, 6, 8 electrons, and suggested a new law of uniform atomic plan that the maximum number of subgroups in a quantum level is equal to one less than twice the quantum number, and that the maximum numbers of electrons in subgroups is equal to twice the natural numbers taken in duplicate, the last and largest subgroup being unduplicated and equal to twice the quantum number. This law was supported by relevant chemical evidence, and has since been confirmed by Stoner's work on spectral multiplicity. The foregoing electronic structures for the rare earth elements, as deduced from the duplicate colour sequence, fully confirm the law of uniform atomic plan, the subgroups for the 4-quanta level being 7 in number and consisting of 2, 2, 4, 4, 6, 6, 8 electrons as in lutecium.

The arrangement of the rare earths into the fore-

<sup>&</sup>lt;sup>1</sup> Hopkins, in "Chemistry of the Rarer Elements," p 107, gives the colour of dysprosium salts as "bright green." This is an error, all being in fact golden yellow.

going two series accords completely with their analytical separation into two groups, the cerium earths lighter and the 'yttrium' earths heavier than gadolinium. Details of the division of the lare earths into the two series on other chemical and crystallographic grounds will shortly be submitted to the Chemical Society.

J D Main Smith

University of Birmingham, Sept. 20.

# The Films Responsible for Oxidation Tints on

The colours produced by heating metals in air have long attracted interest. Within the last three years it has proved possible in two cases (lead and iron) to separate from the basis metal the oxide-films responsible for these tints. In the case of lead, which is liquid at the requisite temperatures, the oxide-film is lifted off the molten metal on glass (*Proc. Roy Soc.* A, 107, 228, 1925), whilst in the case of iron the method employed is that originally worked out for the isolation of the much thinner, invisible skin responsible for the passivity of iron treated with oxidising agents. This method (*Jour Chem. Soc.*, 1020; 1927) consists in undermining the oxide-film by dissolving away the metal below it with iodine solution, so that the film comes peeling off in cuiling fragments, which can be washed by decantation and examined under the microscope

The chemical aspects of the matter have been discussed in the two papers quoted above, but there are certain physical observations which may perhaps deserve to be put on record. There is a remarkable difference between the oxide-films stripped from lead and iron respectively. The lead oxide film is highly transparent, and the film itself, when separated from the metal, shows interference colours, depending on the thickness, the tint by reflected light being always complementary to the tint by transmitted light. As a result of the transparency, the higher order colours corresponding to thick films can easily be observed, the second-order tints being as vivid as the first-order colours; at greater thicknesses third and fourth orders The sequence of tints is essentially the same as that exhibited by silver exposed to iodine vapour, silver iodide also being a transparent substance

When we come to iron, however, the state of affairs is different. Viewed by reflected light, the film fragments show a brilliant metallic lustre, and in some cases might easily be mistaken for metallic iron; they retain all the surface irregularities displayed by the original metallic surface before its conversion into oxide; thus if the abrasive treatment originally used to produce a clean metallic surface has left a series of microscopic grooves and ridges on the metal, the films are crenulated in a manner which faithfully reproduces these grooves and ridges. However, on altering the illumination so that the films are viewed by transmitted light, it is at once seen that they consist of a transparent substance, with only occasional opaque points consisting mainly of minute spots of residual metallic iron embedded in the oxide and usually arranged in lines following the grooving (these particles of residual iron are best shown up as expanding blue spots by treating the film fragments with an acid solution of potassium ferricyanide). But the transparency of the oxide films is distinctly less perfect than that of the corresponding lead oxide films: even the film responsible for the first-order yellow tint has a perceptible yellowish-grey colour, clearly due to specific absorption, whilst the films become darker and darker as we proceed along the sequence, so that the films to which the second-order tints are attributable show a quite dark brownishgrey appearance by transmitted light.

This specific absorption is more than sufficient to mask any colour due to interference, and consequently the films—unlike those separated from heated lead do not themselves show bright tints, although the character' of the brown colour varies slightly with the thickness—possibly as the result of interference of the 'thin-film type' It may perhaps seem curious that the films should nevertheless produce colours when in contact with the metal. In my opinion an explanation can be given. Any theory based on interference between the light reflected respectively from the outer and inner surfaces of the film would lead us to expect that a slight degree of opacity will, at low film thicknesses, actually favour the production of colour, since it will tend to reduce the inequality between the intensity of the two reflections. when, however, the film is off the metal, the two reflections would be approximately equal in intensity in the case of a highly transparent film, and the slightest opacity will be unfavourable to the effect The serious opacity of the thicker films of iron oxide explains why the second and third order tints—so conspicuous in the case of lead—are badly developed on iron, even when the film is still on the metal. After the end of the first-order tints, the colours become faint and are modified somewhat by the specific colour of the scale, which, although slightly yellowish by transmitted light, is a rather bluish grey by reflected light. Nevertheless, there has been no difficulty in tracing the sequence as far as the thirdorder red, the sequence being essentially the same as that shown by lead or copper.

ULICK R EVANS.

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### Adsorption of Gases on the Surface of Mercury.

CERTAIN methods of measuring the surface tension of mercury, especially the 'big drop' method as used by Popesco (Am. de Physique, 3, p. 402, 1925), appear to show that the presence of an or other gas mercases the surface tension of a freshly formed surface by about 100 dynes. The 'drop weight' method, on the other hand, shows a difference of only a few dynes between the values in air and macuo, and this indeed in the opposite sense to that indicated above (Harkins, Jour. Am. Chem. Soc., Dec. 1920). Observations by the writers using the same mercury in order to measure its surface tension by the above as well as other methods show that the differences in the measured values of the surface tension are due to differences in the method and not to differences in the quality of mercury (Trans. Faraday Soc., May 1927).

It is therefore especially important to gain some information as to the adsorption of gas by a freshly formed mercury surface. This has now been accomplished by applying to gases a method similar to that used by Schofield for solutions (Phil. May., Mar. 1926) A shower of about 500 drops per second of mercury falls down a vertical tube about 50 cm. long to the middle of which is sealed a side-tube. Through this side-tube is fed a slow stream of either hydrogen or argon containing a small percentage of carbon dioxide. The stream of gas divides and is taken from the vertical tube by two outlets, one near the top and the other near the mercury surface at the bottom of the tube. From these outlets the gas passes to the tubes of a Rayleigh interforometer.

Any gas adsorbed by the falling drops is given up at the bottom of the tube, and if the carbon dioxide

is selectively adsorbed, this will cause an increase in its concentration in the lower tube and a corresponding decrease in the upper tube By counting the drops and measuring the volume of mercury passing each second, the area of surface can be estimated, while the concentration change indicated by the interferometer and a knowledge of the rate of flow of the gas enable the amount adsorbed per unit area to be calculated Measurements indicate that for concentrations of 5, 10, and 15 per cent, carbon dioxide in either hydrogen or argon, approximately a complete monomolecular layer of carbon dioxide is adsorbed within one-fifth of a second after the surface is formed At a concentration of one-half per cent. the adsorption appears to be definitely less, and at fifty per cent. definitely more, than is accounted for by a monomolecular layer

Later it is hoped to publish a detailed account of the work, together with measurements of surface tension of both the 'big-drop' and 'drop-weight' methods of surfaces formed in similar mixtures of gases. Measurements of the weights of mercury drops falling from tubes wetted by the mercury (amalgamated platinum or copper) in general yield greater values for drops formed in air than for those formed in vacuo, so it seems at least possible that the 'drop-weight' method of measuring surface tension gives different values according to whether the liquid does or does not wet the tube.

inquid does or does not wet the tube. M L. OLIPHANT R S. BURDON.

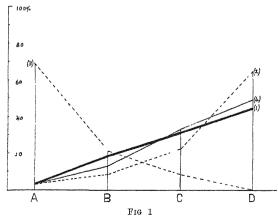
University of Adelaide.

## Periodicity of Molecular Numbers.

I BELIEVE the following facts will serve a purpose in disclosing a new molecular structure principle. Construct a table as follows:

$\boldsymbol{A}$	B	C	D
Minimum	Marine Marine	0	2
4	6	8	10
12	14	16	18
20	22	24	26
28	30	etc.	etc.

Let these figures represent molecular numbers (total atomic numbers) of compounds containing no elements beyond scandium. The distribution of mole-



cular numbers of certain classes of substances among these four groups reveals a marked preponderance of one group and a corresponding deficiency towards another. The diagram (Fig. 1) indicates the percentage of occurrence, in each group, of the following sets of compounds (1) 244 gases having b p 100° C. or below, (2) 57 inorganic acids, (3) 24 most familiar bases, (4) a random set of 60 ions where a unit was added to or subtracted from the total atomic numbers of each for every negative or positive charge respectively.

The striking contrast between the curves of acids and bases is significant, as well as the similarity between those of gases and ions. There is the following connexion between my table and isometric polyhedrons, on the grounds that atomic numbers represent fundamental units which tend to occur in pairs: a pair on each face of a cube, or of combinations thereof, produce numbers of group A, or of group Bif a pair be assumed in the centre of the configuration as well; a pair on each face of any isometric solid, excepting those just mentioned, will give a number of group C, or of group D if a pair be also assigned to the centre It may be stated that the properties of ions and molecules are periodic functions of their molecular numbers, under certain restrictions, and it must not be overlooked that we are now considering only the first 21 elements of the periodic system, for reasons which cannot be discussed here

L W. Tibyriçá. Caixa 1330,

São Paulo, Brazil, Aug 15

# Critical Potentials of Copper by Electron Impacts.

THE following method has been used successfully in the determination of some of the critical potentials of copper by electron impact. Essentially the method is the ordinary three electrode one in which an equipotential source of electrons, a gauze, and a receiving electrode are used. The gauze in this case was made of a copper strip 0 025 mm, thick, through which holes were bored. This gauze was heated electrically and served as a source of copper vapour, the electrons being accelerated to it at the same time.

The critical potentials observed, together with the values calculated from the spectroscopic data given by L. A. Sommer ( $Zeit.\ f\ Phys.,\ p\ 711,\ Nov.\ 1926$ ), are as follows .

State of Atom.	Observed voits	Sommer's value
Ionised .	. 77	7.69
$^{2}D_{3}$ , $^{2}D_{2}$	1 61	1.38, 1.64
$2^{2}P_{1}, 2^{2}P_{2}$	. 3.80	3.77, 3.80
$^4P_3$	4 84	4.87
$^{2}D_{3}^{^{-}}$ .	5.65	5 75
$3^2P_1$	6.08	6.09
$3^{2}S_{1}, D$	6.73	6.52, 6.75
${}^{2}D_{3}^{2}$ .	8 26	8 28
$^{2}G_{5}$	8.73	8.73
${}^{2}P_{1}^{'}$	. 9.40	9 27
•••	. 10.07	10.01
Ionised .	10.91	10.90

One other critical potential observed at 26 volts corresponds to no spectroscopic transition and may

possibly be due to an impurity.

The question might be raised whether the value of 9.4 volts might not correspond to an ionisation from the metastable D state. This would require 9.52 volts. This does not seem probable, however, as it would require two electron impacts. On account of the low vapour density available and small electron current, any effect depending on two electron impacts would be too slight to be noticeable.

The method is being applied to other metals.

H. B WAHLIN.

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## Mud Volcanoes of Minbu, Upper Burma.

The accompanying photographs of the mud volcanoes of Minbu in Upper Burna may be of interest to readers of Nature Minbu is on the Irrawaddy, near the oil-fields of Yenangyaung. The volcanoes are small hillocks of grey mud or clay. The hills begin as holes, from which mud oozes and forms continually growing cones Inflammable gases are also exuded with the mud The local people associate superstitious ideas with the volcanic activity

Fig. 1 is a general view of the mud volcanoes. Fig.



Fig 1 -Mud volcanoes at Minbu

2 shows instantaneous stages of bubbles of mud in the crater of the largest volcano. The crater is about 5 ft. across; and the bubbles in Fig. 2 were about

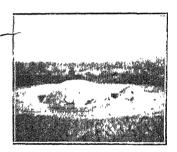




Fig. 2.—Stages in bubble formation.

1½ ft. in diameter. The mud is thick, but cold, with a faint odour suggestive of crude petroleum.

V. V. Sohoni.

Alipore, Calcutta, India.

# Flame and Combustion.

WE want to thank Prof Armstrong for his breezy review of our book in NATURE of Sept. 24 and his suggestions for improving our brains Before putting on the 'thinking cap,' however, we would like to ask him why, in discussing flame-reactions, he asserts that we "ignore the prime fact, that the heat of combustion of carbonic oxide is below that of hydrogen; . . It cannot, therefore, he oxidised by steam For, in our 'nursely' days, we were taught that it is the other way round, and that, volume for volume, hydrogen burning to steam gives out about 16 per cent. less energy than carbonic oxide burning to carbon dioxide; also that the change from the system  $CO + H_2O$  (steam) to the system  $CO_2 + H_2$  is exothermic. If, as Prof. Armstrong says, we are wrong, we have sinned in such good company as Berthelot, Julius Thomsen, and indeed every other investigator of heats of combustion On the other hand, if we are right, does not the 'snag' in his combustion theory thus stand self-revealed? Is there, indeed, any evidence that not 'hydrone' (steam) but something much more complex and 'hydronolie' (water) is formed in flames?

Doubtless Prot. Armstrong will dismiss all this as of no consequence, as he does our spectroscopic evidence, namely, that the flame spectra of dry CO-air explosions at high initial pressures show no vestiges of 'steam lines'. We regard it as conclusive against his theory. Such being the case, we do not wonder that he wants our laboratories to be shut up whilst he settles the matter for us intellectually.

WILLIAM A. BONE D. T. A. TOWNEND.

- The heats of formation given by Thomsen are.

 $H_2$ , O = 68360 CO, O = 67960

I take into account the heat of formation of water, not that of hydrone (steam), between which there is a protound difference—Prof. Bone already has kindly given me credit for carrying my imagination far in these matters: I would ask him to try to follow me ere we begin to dispute.

H. E. Armstrong.

# High-Frequency Interruption of Light.

At my suggestion, Messrs, Adam Hilger and Co. have made the experiment of passing a beam of light through a quartz piezo-electric resonator placed between crossed Nicol prisms.

When the crystal plate is excited to resonant vibration by an applied oscillating voltage from a valve-circuit, light is strongly transmitted, and examination of this light in a rotating mirror shows that it consists of regular flashes, the frequency being apparently double that of the electrical oscillations. The effect is best obtained when the light is passed in a direction parallel to that of the optic axis or, to avoid rotatory dispersion of white light, at an angle of 22°½ with this axis. An attempt to photograph the flashes passing through a crystal oscillating at 144 kilocycles per second on a high-speed film camera was unsuccessful, but faint striae were obtained on a plate moved slowly across the beam after resolution

Any bright source of light may be used, the colour of the flashes of light from a white source changing, however, as either Nicol is rotated. With monochromatic light the interruption is probably complete.

It would seem probable that the high frequency and perfect regularity of the flashes there seems no reason why ten million per second, or more, should not be possible render this method superior to all others, such as the toothed wheel of Fizeau, the rotating mirror of Foucault, or even the so-called 'Kerr' cell recently employed for television - which have hitherto been used to obtain rapid intermittence in a beam of light.

The application to a variety of physical determinations such as the measurement of light-velocity, exact comparison or even absolute determination of crystal frequencies, production of a time-base on a moving film, etc., is obvious, and the method may also prove valuable in telegraphic transmission of pictures and in the photophone. The intensity of the flashes can readily be modulated by modulating the oscillating voltage applied to the crystal.

I wish to thank the management of Messrs. Adam Hilger and Co. for so kindly giving facilities for the experiments, and Messrs. Underfull and Brown of their staff for the interest and skill which made the demonstration of them a success.

Kerr Grant.

# Clustering and Periodicity of Earthquakes.

By Dr. CHARLES DAVISON.

I VERY few years we pass through a season of marked earthquake-frequency, or, as Mallet called it, a 'period of paroxysmal energy' In the mere fact of clustering, there is nothing remarkable, it is its intensity, rather than its existence, that is worthy of notice In Italy, for example, as Mercalli pointed out, 209 destructive earthquakes occurred between the years 1601 and 1881, and 182 of them in 103 years <sup>1</sup> In other words, the average frequency of great earthquakes during one of the cluster-years was eleven times that

during one of the remaining years

The first seismologist who examined the clustering of carthquakes, the first, indeed, who possessed the necessary materials, was Robert Mallet 1858 he drew curves representing the frequency of earthquakes in each year from 1500 to 1850 The intervals between successive maxima in these curves varied widely Though he could trace no law in their variation—it should be remembered that he counted weak shocks as well as strongtheir average duration was found to he between five and ten years, the shorter intervals being those of fewer, and usually weaker, earthquakes <sup>2</sup>

Fifty years later, John Milne went close to the heart of the problem by suggesting that variations of seismic activity in distant regions may be synchronous. Considering the earthquakes from 1899 to 1907, he noticed that, during the last six years, the annual numbers of 'large earthquakes' on the eastern and western sides of the Pacific rose and fell together In the following year he found that the destructive earthquakes of Italy and Japan during the last three centuries occurred in periods of activity, the intervals between them ranging from five to twenty years, and that, of the eighteen years of maximum frequency in Italy, fourteen agreed with years of similar activity in Japan "These coincidences suggest," he says, "that a relief of seismic strain in one part of the world either brings about a relief in some other part, or that relief is governed by some general internal or external agency "3

At this time, Milne's catalogue of more than 4000 destructive earthquakes was still unpublished, though it must have been approaching completion. It is on the fuller portion of this great work—that relating to the northern hemisphere from 1750 (and for some purposes from 1701) to 1899—that the present inquiry is based. My object at first was merely to ascertain if the cluster-years for different intensities were the same or in any way related, and this work led to the recognition of several periods in the recurrence of cluster-years. I hope to give fuller details of these periods in a

later paper.

To each earthquake Milne assigned an intensity

1 (4 Mercalli, "Vulcani e fenomeni vulcanici in Italia," 1883,

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according to a scale of three degrees Shocks of intensity I. were strong enough to crack walls or chimneys or to shatter old buildings By those of intensity II, buildings were unroofed or shattered and some were thrown down. Earthquakes of intensity III. destroyed towns and desolated districts In order to smooth away minor inequalities, I have taken three-yearly means of the annual numbers of earthquakes of each intensity The corresponding curves show definite years of clustering, which are given in the following table:

			Int III	Int II	Int I	Sunspot Minimum
A B			1754–56 1765–66	1755–56 1767	$1755-56 \\ 1766-67 \\ 1771-73$	1755 1766 1775
C			1785–90	$\begin{pmatrix} 1784 - 86 \\ 1789 - 91 \end{pmatrix}$	1771-73 17785-86 17791-92 1799-1800	1775 1785
D E F			1810-11 1822-23	1811 1818–20	$^{1811-13}_{1821-22}$	1810 1823
G		•	1828-29 $1834-36$ $1840-41$	1827 1832 1840–42	1827–29 1840–42	1833 1843
H			1845–47 1852–57	1846-48 1852-56 1859-60	1846-47 1852-57 1861-63	1856
K	•	٠	1868-72	1869-72	1867 1873-74 1880-81	1867
L M	:	٠	1884-86 1892-93	1884 1893–94	1885–86 1895	1889

It will be seen that, in all three classes, there are twelve clusters at approximately the same times. They are denoted by the letters A-M <sup>5</sup> There are also six other clusters, two common to two classes, and four of earthquakes of intensity I. only. Of the latter, two may not be real exceptions, for in the other classes there are traces, too slight to be otherwise noticed, of clusters about the years 1773 and 1798. In any case, the existence of at least four of these additional clusters seems to imply that they are not consequences of the great shocks of intensity III., but rather that the clusters of all classes are the effects of some common cause or

More important, however, than the coincidences of the clusters are the intervals between the years of maximum frequency. Some of the intervals are so suggestive of an eleven-year period that it was only natural that the cluster-years should be compared with the turning epochs of sunspot frequency. The last column of the table shows that eight clusters in all three classes (A-E, G-K) agree closely with the years of low sunspot frequency, and that this correspondence also holds for three other clusters (1771-73, 1799-1800, and 1832 or 1834–36) which appear in only one or two classes. The only divergences are for the last two years of sunspot minima.

pp 353-355 2 Brit Ass Rep., 1858, p 49 and plates 1-6. 3 Brit Ass. Rep., 1908, pp. 63-64, 1909, pp 56-58 4 Brit Ass Rep., 1911, pp 649-740.

<sup>&</sup>lt;sup>5</sup> The date of the maximum epoch M may be too early, for, towards the end of the century, the catalogue may not be quite complete.

In order to test more closely the existence of an eleven-year periodicity, I counted the numbers of earthquakes of each intensity in the years 1755, 1766, . . , 1887, 1756, 1767, . . , 1888, and so on, and took five-yearly means of these eleven sums, with the following results, the first subsequent year of least sunspot frequency being 1765:

Intensity	Fust Maximum Epoch	Amplitude		
III	1764 1762–63 1763–64	0 16 0 12 0 09		

Thus, in destructive earthquakes of every intensity, the maximum-epoch of the eleven-year period occurs shortly before the epoch of least sunspot frequency, and the amplitude increases with the intensity of the shock. It may be added that the epochs are almost exactly the same for the same three classes for the separate intervals 1701–99 and 1801–99, and for all three intensities together for the interval 1501–1698, and for each season of the interval 1701–1898.

It is interesting to notice that the same periodicity holds in widely separated regions. Taking the three intensities together, the maximum occurs in 1764 in Europe, in 1763-64 in Asia, in 1764 in

Italy, in 1764-65 in China, and in 1763-64 in the island groups of the western Pacific. Even in the slight earthquakes of Great Britain, the same period is present with its maximum in 1763-64. Thus, by a somewhat different line of evidence, Milne's remarkable generalisation seems to be confirmed.

In addition to the eleven-year period of destructive earthquakes, there are other clearly marked periods of 19, 22, and 33 years, the maximum epochs of which (1754, 1760, and 1757) agree closely in widely distant regions of the northern hemisphere. Some of these maxima seem to be responsible for clusters in the above table, especially for those of the years 1791, 1847-48, 1880-81, and about 1887. To the occurrence of their minima about the years 1798, 1833, and 1878, the absence or slightness of clusters is probably due.

During the present century, the maxima of the 11, 33 and 19 year periods occurred in 1918, 1922 and 1925, those of the 11, 22 and 33 year periods are due in 1951, 1958 and 1955, and those of the 11, 22, 33 and 19 year periods in 1984, 1980, 1988 and 1982. The times of unusually frequent earthquakes are thus, 1918-25, 1951-58 and, especially, 1980-88. The first of these intervals is notable for its very numerous earthquakes, some of which, such as the Chinese earthquake of 1920 and the Japanese earthquake of 1923, were of great violence

# Invention as a Link in Scientific and Economic Progress.1

By Sir James B. Henderson.

INVENTION forms the natural link between physics, chemistry, and engineering, and every advance m one or other of these produces a reflex action on the other. For example, a discovery in physics which increases accuracy of measurement by providing an indicator more sensitive than any previously known, is soon embodied in an engineering instrument carefully designed and manufactured for sale at a price which makes it available to every physicist for use in further research. Thus modern research in physics and chemistry is carried out with accurate apparatus which would be available only at a prohibitive price if it had been made for the particular research alone. The assemblage of apparatus used in a modern research is sometimes like an engineering installation, and is in marked contrast with the cruder, home-made apparatus, designed ad hoc, which was common a generation ago.

The closer the intercourse between the physicist, the chemist, and the engineer, the greater will be the fertility in invention and the faster the economic progress. The physicist working continually in a laboratory where everything is specially designed to facilitate accuracy of measurement and to eliminate disturbance, is apt to forget how artificial his working conditions really are, and that before any of his beautiful experiments can have

a practical application in industry a great deal of invention is required.

As an example of successful invention involving an accurate measurement to be made under practical conditions unsuitable to accuracy, I may cite the Barr and Stroud range-finder, which was invented by two young professors in the Yorkshire College, Leeds. The problem consisted in measuring with great accuracy, say to a second of arc, the small angle subtended at a distant target by a short fixed base placed at the observer. At the time when this invention was made, some forty years ago, the only scientist who normally measured angles to seconds of arc was the astronomer with his large telescopes mounted on great concrete foundations, with graduated circles from three to six feet in diameter and microscopes to read the scales. It seemed, therefore, impossible to contemplate the measurement of angles with anything like equal accuracy on board a rolling ship and with no expert operator.

Yet the two inventors, seeing an advertisement in the pages of *Engineering* announcing competitive trials of range-finders to be held by the War Office, took this seemingly impossible task in hand There was little time to spare. The first instrument was designed in outline in a week, and much of the subsequent success is attributable to the sound physical principles underlying this

<sup>1</sup> Continued from p. 553.

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design and to the very ingenious design of all the constructional details, due to the happy combination of an engineer and a physicist, both of whom were men of imagination with a flair for invention. Their range-finder was constructed in the College buildings and, to indicate the amount of time that was available, the final adjustment of the instrument was made on a star from the railway platform at Rugby on the way to the trials at Aldershot

During the trials the instrument worked well at first, but after the sun came out it commenced to read 'as thousands of yards ranges which were palpably a few hundred 'and the inventors dis-covered that their beautiful angle measurer was also a thermometer and a sunshme recorder combined They were not surprised to have it rejected, and they might actually have abandoned it entirely if they had not been asked by the Admiralty some time later to submit an instrument Then followed ten years of most for naval use patient struggle against physical and engineering difficulties, not to mention financial difficulties, for the inventors acted as their own promoters and the financial side of the business must have taxed their resources to the utmost But at last they succeeded, and their range-finder is now the standard instrument in the British Army and Navy, and in other countries as well, and has been the foundation of one of the best firms of scientific instrument makers in the country As student or as assistant I had the honour to serve under both Prof Barr and Prof Stroud, both of them great teachers, versatile inventors, and most lovable men, and I am happy to be able to pay this small tribute to them and to their great achievement.

# THE DIFFICULTIES OF INVENTION AND THEIR REMEDY.

I wish it to be understood that where I have used the word 'invention' I am dealing with the great inventions, and not with the thousand and one minor and comparatively unimportant, though useful, inventions which flood the Patent Office every year. The latter are generally simple affairs, a minor improvement in a known mechanism or a new way of performing an old simple I do not wish to belittle these minor inventions in any way. They serve their purpose in our everyday lives, and all are traceable more or less directly to some major invention of the past, but the distinction which I wish to draw is that in very few cases is their manufacture or development a matter of difficulty I am therefore dealing solely with the big inventions and their development, and it is to the question of the obstacles that are too often encountered in their development that I wish to draw particular attention I wish now to examine the question of how to eliminate, or at least minimise, these difficulties that obstruct the inventor and so retard the march of progress.

The first way that suggests itself to me is by means of education. Our educational policy in schools on the scientific side deals with physical

laws as facts, and the teacher generally deals only with phenomena with which he can afford to be dogmatic and ignores the enormously greater range of phenomena about which science knows little or nothing This system inevitably breeds in the student and in the general public the impression that Nature acts according to certain definite laws and that there is nothing about these laws which is not known to science In actual fact, the more the scientist knows about these laws the more he is impressed with his ignorance and the failure of science to fathom the complexity of Nature. Much of the misunderstanding of invention and its difficulties is due to this method of teaching, and will endure so long as this method is maintained If it were possible to teach physical and chemical science historically, much could be done to counteract this injurious effect

The experimental laboratory tends to modify the dogmatic teaching of the schools because the student there finds out for himself how exceedingly difficult it is to prove experimentally some of the simplest of the physical facts which he learned in the lecture room, and he thus gams a first-hand knowledge of the order of accuracy of physical measurements and of the difficulty in attaining it. Science taught historically would be infinitely more interesting and instructive, but time is the great In a recent leading article in the Times obstacle the teaching of the history of science was advocated as a subject for general culture, and comment was also made on similar recommendations emanating from an American writer. Such a study would introduce a better understanding of the science of invention among those who have not given particular attention to it, and the inventor might come to be regarded as a necessary and valuable cog in the wheel of industrial progress, and not, as he is too often regarded, as a freak. After all, the inventor is simply trying to make things simpler and easier and safer for his fellow-men, and he is succeeding beyond belief. Surely that object is worthy of recognition and encouragement.

A second possible remedy to encourage invention and minimise its difficulties is by means of legislation. I hesitate to enlarge on this point because the question of patents is a controversial one among scientists, and between inventors and the outside public, but it seems to me anomalous that a man who makes an epoch-making invention which is going to revolutionise an industry and add millions to the wealth of the nation, receives exactly the same degree of protection for his invention as the man who invents a new kind of shirt button. In the first case the invention will take years to develop, and may cost thousands of pounds in the process, and by the time it reaches the productive stage the patent may have expired In the case of the shirt button, a term which I use figuratively, there are no difficulties to overcome, practically no expense, no loss of time, and a clear sixteen years' trade monopoly

I know that a patent is granted only for a new method of manufacture, which has to be described in the patent specification so that any one skilled in the art may put it into practice at once simple inventions which form the subjects of the great majority of patents this is actually the case, but there are undoubtedly cases where what appears to the inventor to be a practical scheme, and was honestly described by him as such, proves afterwards to be difficult to put into effect on account of technical difficulties which he had not foreseen, and the remedy for which may not Such obstacles and their remedy be patentable cannot be recorded in the patent, because they have not been encountered when the specification Under our present system a period of nine months is allowed between filing the provisional and complete specifications, which period, while ample in the case of most inventions, is madequate for full investigation of the really great inventions, and it is to this difference between major and minor inventions that I wish to direct attention

In America it is possible for an applicant for a patent, by filing periodical amendments of his specification, to keep the application pending in the Patent Office for a number of years, during which he can be developing the invention and adding to the specification any further explanations which may be called for in the light of the experience gamed. Then when the patent is eventually issued, it runs for seventeen years from the date of issue, whereas a British patent dates from the date of application. In addition to this, an American patentee, on any question of priority of invention, is allowed to produce any evidence that may be available to show conception of the invention up to not more than two years anterior to the date of his original application. In this way an American inventor can spend several useful years perfecting his invention before his patent is granted, while the British inventor has often to watch the most useful years of his patent being eaten up in unproductive development.

I admit that the American system has drawbacks from the point of view of an industry, but it has certain undoubted advantages, and I suggest that the British system does not meet the needs of great inventions, between which and the ordinary minor inventions there ought in my opinion to be some discrimination. Merely as a suggestion, I see a possible solution in an extension of our present system of granting Patents of Addition, that is, a patent for an improvement on a prior patented invention, the Patent of Addition being granted during the lifetime of the original patent and running conterminously. If a Patent of Addition could be granted to an inventor in approved cases on production of evidence of genuine difficulties encountered and successfully overcome, these difficulties and their remedy to be fully described in the patent for the guidance of the industry, and if this Patent of Addition could be made valid for a definite term of years, one of the main fears of a patentee would be overcome.

It will be noticed that in this last suggestion I have stipulated that the specification of a Patent of Addition such as I suggest should contain

not only a description of the finished invention but also of all the difficulties encountered in its production and the steps taken to surmount them In fact, it is mainly for this reason that I make the suggestion at all I am trying to devise a means to prevent future inventors and industry from being handrcapped in a way that has been all too common in the past. I have already touched on what must be the large volume of valuable scientific information that has been lost through lack of records of past difficulties Patent specifications are m many cases the sole record of inventions, yet in the cases of the type I have mentioned they tell us nothing of the difficulties, simply because the specification is written before the difficulties are encountered. I therefore suggest that if any additional protection be given to a patentee in virtue of work done in converting his invention into a practical mechanism in face of unsuspected obstacles, the grant should be absolutely conditional on his placing on public record for the guidance of others a complete history of his efforts so that no one may have to contend with the same troubles again

I have one more suggestion to offer. On this question of assisting future inventors by increasing the store of knowledge at their disposal, I see a possible sphere of usefulness for the British Association and kindred institutions by encouraging the great inventors of to-day to place on record and publish through the medium of the Association or institution an account, even a brief one, of the main historical features of their inventions. If considerations of patents or of personal diffidence make it undesirable to publish these records at the time they are written, that need not impede the scheme, as publication could be made afterwards at a more convenient time or, say, after the inventor's death. The main thing is to have some authentic record from the inventor or discoverer himself recording the origin, growth, and development of his idea, the difficulties that beset him, and the manner in which they were overcome.

Nor do I think we should stop there. In my opinion too much attention has been paid in the past to success and too little to honest failure. It is one of our human frailties to look with something of contempt on the man who has failed to reach his goal, but this is not the attitude of the great minds, nor should it be the attitude of modern science On one occasion Lord Kelvin was shown a report by a professor on a research carried out by a research scholar, in which the professor had made some rather contemptuous remarks on the results attained because these results were mainly negative. Kelvin was highly indignant. All he looked to was the fact that the young scholar had done his best on a subject which merited investigation and in face of undoubted difficulties, and it amazed him that any scientist should speak slightingly of the results, simply because they were negative, when the real thing of value was the earnest and diligent search after truth.

If, therefore, my suggestion be adopted by the

British Association, would it not be in the best interests of science to remember the failures as well as the successes, and to encourage all serious workers in important fields of research to furnish in the common cause a record of their work, even when their aim has not been achieved, giving a faithful account of all the difficulties and all the efforts made to surmount them? Who knows but that many of the so-called failures of yesterday may only be waiting for other hands to-day to carry them on to a greater success than the world has yet known? Left to themselves they will lie in oblivion, yet, for all we know, two of them may fit together and provide the answer to one more of the riddles of the universe

Knowledge forms the working tools of science, and my proposal is in no way aimed at giving the scientific workers of to-morrow an easy task will probably have a far more difficult task than ours, but I do not think it fair to condemn them to spend part of their time in a preliminary and possibly fruitless search for tools which we have forged and hidden

As one lamp lights another, nor grows less," science of to-day will partly fail in its clear duty if it fails to pass on to to-morrow any of the knowledge which it has been privileged to acquire, or if it forgets that it is for to-morrow, rather than to-day, to assess the true value of to-day's success

and failure.

# Obituary.

Prof. W. Einthoven, For Mem RS DROF. WILLEM EINTHOVEN, whose death on Sept. 28 at the age of sixty-eight years has been announced, was one of the foremost of modern physiologists. For nearly forty-two years he has been professor of physiology at Leyden, Holland, being invited to succeed Heynsius in November 1885, and actually taking up his duties, after passing his final State examination in medicine, on Feb 24, 1886. For the first twenty years of his office the chair of physiology was combined

with that of histology.

Einthoven was born in Semarang, in the Dutch Indies, where his father was in medical practice. After his father's death, his mother with her six children settled in Utrecht, where Einthoven was educated at school and as a medical student in the University. He spoke with gratitude of his teachers there, particularly of the physicist Buys Ballot, and then of the anatomist Koster, the ophthalmologist Snellen, and the physiologist Donders. His first scientific investigation was carried out with Koster on the mechanism of the elbow joint; he assisted Snellen both in private practice and in the clinic, and in 1885 his dissertation, "Uber Stereoskopie durch Farbendifferenz," was approved by Donders for the degree of doctor of medicine.

Einthoven's investigations cover a wide range, but they are all notable for the same characteristic —the mastery of physical technique which they Einthoven, in spite of his medical training and his office, was essentially a physicist, and the extraordinary value of his contributions to physiology, and therewith indirectly to medicine, emphasises the way in which an aptitude—in Emthoven's case a genius—for physical methods can aid in the solution of physiological problems. His papers are published in the Nederlandsch Tijdschrift voor Geneeskunde, Archives Néerlandaises, Archives Internationales de Physiologie, Brain, Quarterly Journal of Experimental Physiology, Annalen der Physik, and especially in Pfluger's Archiv für die gesammte Physiologie. He wrote an article in Heymann's "Handbuch der Laryngologie und Rhinologie," and edited ten volumes of "Onderzoekingen Physiologisch Laboratorium, Leiden.'

Einthoven's name is connected chiefly with the string galvanometer and the electrocardiogram. The potential differences involved in the electrical phenomena of the heart beat are fractions of a millivolt and occur in thousandths of a second The problem of recording these small and fleeting changes, previously attempted without complete success with the capillary electrometer, was solved in 1903 by the invention of the string galvanometer, to-day there are hundreds, probably thousands, of these instruments all over the world, and they have been applied not only to their original purpose of registering the action current of the heart (and incidentally of muscles, nerves, and retina), but also to such diverse uses as finding the velocities of shells, receiving and recording wireless signals, and locating enemy guns, and I believe it is true that Einthoven never received any material profit from his invention. In 1909 he published the first complete description of the instrument, while in the last few years, employing fibres of almost ultramicroscopic size working in a high vacuum, he has succeeded, in collaboration with his son, an electrical engineer, in recording potential changes of frequencies of the order of 100,000 per second. It may be mentioned also that recently, by means of fibres of extreme thinness, he was able to register directly, and with very little distortion, sound waves of more than 10,000 vibrations per second.

Einthoven's most important work, for which he was awarded the Nobel Prize in 1924, was his discovery of the mechanism, of the manner of production, of the electrocardiogram and its characteristic waves. In many directions the diagnosis of maladies of the heart has improved in recent times, but the greatest single advance was made by Einthoven in applying the string galvanometer to the investigation of the electrical phenomena of the normal heart-beat. This work was followed up, particularly by Sir Thomas Lewis in London, and has resulted in a clearer understanding of the cause of some common disorders of the heart, and in improvement in their treatment.

Of the more personal side of Einthoven's life one might write of the grace, beauty, and simplicity of his character He spoke with ease three languages as well as his own, he was a regular attendant at international gatherings, he threw all his influence on the side of good international Last summer he was present relations in science at the International Congress of Physiology at Stockholm, and attended the various functions, and took part in many of the excursions, including a trip to the north of Sweden and back by sea along the Norwegian coast. It was a wonderful thing to be his guest and to enjoy the delightful hospitality of his home. He invited me some years ago, while we were attending a German congress of physiologists at Tübingen, to stav with him at Leyden on my way back to England We arranged to meet at a station m North Germany and to travel the last part of the journey together I waited until his train arrived. He came literally running along the platform to meet me, seized my bag out of my hand, carried it to the carriage, where he had kept me the best seat, and made me feel that whatever the difference of our age and position, I was from that moment his honoured guest. In 1924 we sailed together to America, and at night under the starlit sky we walked on the upper deck discussing the random movements of electrons in conducting fibres and other matters equally strange. These personal details will emphasise what a loss his passing will be, not only to his older colleagues and to his younger friends, but also to all the good fellowship of physiologists throughout the world.

Einthoven was elected an honorary member of the Physiological Society in 1924, and in return he invited the Society to hold one of its meetings in his laboratory. The occasion will be a happy memory in the minds of those who were able to go to Leyden in April 1925. In 1924 he visited the United States to deliver a course of lectures at Boston, and while there, the award to him of the Nobel Prize for medicine for 1924 was announced. He was elected a foreign member of the Royal Society in 1926. A. V. H.

Prof. Svante Arrhenius, For. Mem. R.S.

THE annals of physical science bear abundant testimony to the native genius and energy of Sweden, and in this respect Svante August Arrhenius, who has just passed away, upheld with honour and distinction the reputation of his country. Born near Upsala in 1859, as the son of a land steward, Arrhenius obtained his early education in the school and university of that town, moving later to the University of Stockholm, the atmosphere of which was more congenial and stimulating to the young physicist His researches there on electrical conductivity and its relation to chemical activity, although lightly esteemed by the Upsala professors, brought him recognition abroad, whilst the theory of electrolytic dissociation, put forward in 1887 during his Wanderjahre, secured for him an established position in international science.

During these Wanderjahre, with financial support provided by the Swedish Academy of Sciences, Arrhenius visited quite a number of active research centres Thus he worked with Ostwald at Riga, and later at Leipzig (the laboratory which van 't Hoff in 1888 termed the 'Hauptagentur fur Ionenspaltung'), with Boltzmann at Graz, with Kohlrausch at Wurzburg, and with van 't Hoff at Amsterdam

Refusing an invitation to settle at Giessen, Arrhenius returned to Sweden in 1891, and acted first as lecturer and afterwards as professor in the newly established Technical High School at Stockholm Somewhat later he acted as Rector of the same institution for a number of years. Glessen was not the only foreign university which made an effort to secure Arrhenius, for in 1905 he was invited to Berlin This honour was likewise declined, and in the same year he was appointed Director of the Nobel Institute at Stockholm. Arrhenius occupied this position up to the time of his death, and the numerous communications published by the Institute bear witness to the activity of this centre of research under his inspiring leadership.

Arrhenius was a frequent visitor to England, and although his scientific views met with a critical reception in various quarters, his genual and attractive personality made him always a welcome guest. His work secured extensive recognition from British scientific bodies, and he was a foreign member or honorary fellow of the Royal Society, the Chemical Society, the Physical Society, and the Royal Institution Honorary degrees were conferred on Arrhenius by the Universities of Oxford, Cambridge, Birmingham, and Edinburgh, whilst the Royal Society awarded him the Davy Medal in 1902, and by invitation of the Chemical Society he delivered the Faraday Lecture in 1914

In Europe and America also his international standing was marked by his election as corresponding member of numerous academies and learned societies, whilst honorary degrees were conferred on him by the Universities of Heidelberg, Groningen, Oslo, and Leipzig Further, he was the recipient of the Nobel Prize for chemistry

The honoured place which Arrhenius occupied m physical science was without doubt mainly due to his bold and original ideas on the condition of dissolved electrolytes, as expressed in his theory of electrolytic dissociation, and it is on this ground that he is justly regarded as one of the founders of modern physical chemistry. The genesis of this theory in Arrhenius's mind, on the basis of his own experimental work and in correlation with van 't Hoff's researches on osmotic pressure, is worth recalling, for it constitutes one of the most interesting chapters in the history of physical chemistry.

Investigation of the electrical conductivity of forty to fifty substances in dilute aqueous solution had led Arrhenius in 1883 to two striking conclusions: (1) that in regard to conduction of the electric current only part of the electrolyte is to be regarded as 'active,' this proportion increasing on dilution, and (2) that there is a parallelism between the 'strength' of an acid and its electrical conductivity. The conception of the 'activity coefficient' as a 'degree of ionisation' came later, and was not published until Arrhenius had become acquainted with van 't Hoff's memoir on the extension of the gas laws to solutions. The abnormal behaviour of dissolved salts, expressed by the van 't Hoff factor i in the equation pv = iRTwas precisely the point on which Arrhenius fastened as of special significance for his theory of dissociation. He writes from Wurzburg to van 't Hoff under date March 30, 1887. "Die Abhandlung [i e van 't Hoff's memoir] hat mir namlich in unerhortem Grade Klarheit geschafft uber die Konstitution der Losungen," and he proceeds to the correlation of osmotic abnormality and This correlation was the main feature of the communications made by Arrhenius in 1887 to the Swedish Academy, and of the classical paper "Uber die Dissociation der in Wasser gelosten Stoffe," published in the Zeitschrift fur physikalische Chemie. An early announcement of these new developments was made also to Sir Oliver Lodge as secretary of the British Association Committee on Electrolysis.

It was fortunate for the propagation of Arrhenius's ideas that he was in alliance with van 't Hoft, and that he had such an able and enthusiastic advocate as Ostwald. The newly established Zertschrift fur physikalische Chemic, run mainly by Ostwald, provided an effective platform for the discussion of the new theory and the relevant experimental investigations. Arrhenius's views evoked strong opposition in many quarters, but as the years passed the utility of this theory as a basis for the study of solutions on quantitative lines became more and more apparent. The theory stimulated a prodigious amount of research, and if modifications have been made and are still being made, the ideas of Arrhenius have nevertheless yielded an abundant harvest.

In the experimental investigation of problems suggested by the new views on solution Arrhenius himself, as well as his co-workers in the Nobel Institute, took a prominent part. Such matters as the diffusion of electrolytes, neutral salt action, the hydrolysis of salts, the catalytic activity of acids, isohydric solutions, were examined from the viewpoint of electrolytic dissociation, and the extent determined to which the new theory was capable of giving a quantitative account of each case.

The study of physiological and biological problems on quantitative physico-chemical lines was another field in which Arrhenius was active, both theoretically and experimentally. He concerned himself more especially with serum therapy, and many of his original papers and books deal with aspects of this subject, such as the relation of toxins and anti-toxins.

From serum therapy to cosmogony seems a long step, but the latter also was a subject in which Arrhenius was deeply interested, and the varied problems of which occupied much of his thoughts.

The nature of planetary atmospheres, the genesis of the solar system, the origin of the aurora, the influence of carbon dioxide on the temperature of the earth, the function of light pressure, and the periodicity of certain natural phenomena were among the problems on which Arrhenius expressed fresh and original views

The contributions of Arrhenius to serum therapy and to cosmogony were both striking and important, but without doubt the honourable and permanent place which his name occupies in the roll of men of science is due, not to his work in these two fields, but to the fresh impetus given by him to the study of solutions on quantitative lines JCP.

THE RIGHT HON THE EARL OF IVEAGH, FRS

THE Earl of Iveagh, who died on Oct 7 in his eightieth year, distributed large sums for public objects. Consideration for the sufferings of others was one of his noblest characteristics, and his contributions to hospitals in Dublin and elsewhere were on a princely scale When the Boer War broke out, he equipped the Irish Field Hospital, and during the Great War he spent vast sums in increasing the provision for our sick and wounded Lord Iveagh was, however, a philanthropist embued with a spirit of social reform The urgent appeal of sickness and suffering is responded to by many according to their means, but other of Lord Iveagh's repeated acts of benevolence indicate a considered scheme to increase the well-being by improving the health of the people

In 1889, Lord Iveagh gave £250,000 for the substitution of sanitary dwellings for slums in Dublin and London. Nine years later he provided a similar sum to improve a congested and noisome area abutting on St. Patrick's Cathedral, Dublin By this scheme the old dwellings and streets were done away with and a public garden of about two acres was provided around the Cathedral. Upon the rest of the seven and a half acres model dwellings for working people were erected, with a central play-hall for the children.

Prior to 1907 the congested state of the old markets in Dublin and the surrounding areas was not only an eyesore but also a serious menace to the public health. At this date Lord Iveagh bought up the whole area, built modern markets, and presented this valuable property to the city. He was, indeed, a practical hygienist, for there is no better means of improving the health of an urban population than providing it with good housing and opportunities to spend more time in the open air and sunlight. One of the latest of Lord Iveagh's benefactions was destined to increase the facilities for recreation in the open air of the citizens of London. In 1925 he purchased the residue of the Ken Wood property adjoining Hampstead Heath, which the Preservation Committee had been unable to acquire owing to exhaustion of its resources. The whole of this fine place of woodland now becomes public property.

The idea of furthering the public health by stimu-

lating medical discovery seems to have originated in 1896 owing to an accident to one of Lord Iveagh's employees. A labourer upon his estate having been bitten by a rabid dog, he directed that everything possible was to be done for the unfortunate man, but was surprised to learn that the treatment for hydrophobia could only be secured by sending the patient to Paris This was done, and no further ill results ensued, but the novelty of the treatment and the absence of facilities in England for the prosecution of researches such as had led to Pasteur's fruitful discovery made a deep impression on his mind. In 1898, Lord Iveagh visited the Pasteur Institute, and the project of endowing a sımılar ınstitute in London began to take shape Ascertaining that the Lister Institute (then the Jenner Institute) had been founded with the objects he had in view but was languishing for want of funds, he decided, after careful inquiry, to endow the Institute to the extent of £250,000, subject to certain alterations in its constitution and government.

Another institute for medical research, as well as the treatment of patients, which is largely indebted to Lord Iveagh's liberality, is the Radium Institute in Riding House Street, London. This was founded in 1909 to make researches upon the effect of radium on the human organism and to supply treatment to patients whose circumstances did not permit them to receive the benefit of radium treatment without financial help. The whole of the money required for the building, equipment, and endowment of the Radium institute was provided by Lord Iveagh and the late Sir Ernest Cassel

Lord Iveagh made large benefactions for various purposes to his old college, Trinity College, Dublin, and built for it new Institutes for physics and botany, and endowed the school of geology new National University of Ireland also is indebted to him for a valuable site at St. Stephen's Green.

Even a complete list of Lord Iveagh's known gifts for public purposes would fail to record many of the benefits he dispensed. Partly from a distaste | five years of age.

for notoriety, partly for self-protection, the hand of the donor was concealed His philanthropic enterprises were carefully considered and evolved with patience and attention to details. He took a personal interest in all his schemes and often a large part in the direction of them

In 1906, Lord Iveagh was elected a Fellow of the Royal Society under Statute 12 "as having rendered conspicuous service to the cause of science," and in 1908 he was unanimously elected chancellor

of the University of Dublin

We regret to announce the following deaths:

Dr. Charles C Godfrey, president of the American Association of Variable Star Observers, conducted in co-operation with the Harvard Observatory, on Aug. 31, aged seventy-one years.

Dr. B. Daydon Jackson, secretary of the Linnean Society of London for forty-seven years, editor of the "Index Kewensis," and author of other important botanical works, on Oct. 12, in his eighty-second year

Dr. William Libbey, professor of physical geography and Director of the Museum of Geology, Princeton University, from 1883 until 1923, on Sept. 6, aged

seventy-two years.

Prof. Alexander Mair, professor of philosophy in the University of Liverpool, president in 1925 of the Association of University Teachers, and author of "Philosophy and Reality" (1911), on Oct. 8, aged

fifty-seven yours. Dr. J. W. Mollison, C.S.I., formerly Inspector-General of Agriculture in India, who was the first head of the Imperial Agricultural Research Institute at

Pusa, on Oct. 4, aged seventy years.

Dr. Eugene Allen Smith, emeritus professor of mineralogy and geology in the University of Alabama and state geologist since 1873, who was vice-president (Section E) of the American Association for the Advancement of Science in 1904, on Sept. 7, aged

eighty-five years.

Mr. H. M. Taylor, F.R.S., semor fellow and formerly mathematical lecturer of Trunty College, Cambridge, distinguished by his contributions to mathematical science and his translation of many scientific works into Braille for use by the blind, on Oct. 16, at eighty-

# News and Views.

THE amount of change a story can undergo through repeated copying is a commonplace of experimental psychology; and every scientific worker in the habit of verifying original references has met with examples where the actual statements of an early investigator differ substantially from the versions of them to be found in more recent writings. But it is not often that one meets so extreme a case as that given by Mr. Gheury de Bray m a letter to NATURE of Sept. 17, and in an article in the present issue. Of eleven determinations of the velocity of light quoted in standard works, only one turned out to have been quoted correctly. Mr. de Bray's historical work should provide material for any one in need of examples for the precept 'Verify your references.'

In a paper in the Astronomische Nachrichten (No. 5520), Mr. de Bray has used what appear to be the best of the determinations, after due criticism, and has shown that they point to a decrease in the velocity of light of about 200 km./sec, in the last fifty years. As he says, however, the earlier determinations are not good enough individually to determine such a change, and his argument rests on the fact that they all agree in suggesting a change in the same direction. Of the seven determinations retained, one differs from 299,800 km./sec. by 2.2 times its probable error, one by 20 times, and the rest by smaller multiples. In a random set of observations 1 in 5 would deviate from the true value by more than twice the probable error. The velocity of light being so fundamental a constant, physicists may prefer to attribute any change in its measure, if established, to a change in the unit of velocity and not to one in the velocity of light itself. The variation of the second is shown by E W. Brown's recent work to be within a few parts in 107. The possibility of measurement of wave-lengths within a few thousandths of an

Ångstrom unit indicates that the unit of length is equally constant. We can, therefore, scarcely admit such a change in the unit of velocity as would be needed to account for a change in the measured velocity of light of the order of one in a thousand. An absolute change in the velocity of light, on the other hand, could scarcely obtain acceptance unless supported by much more decisive observational material.

An international conference on the Protection of Migratory Wild Fowl was opened, under the presidency of Lord Ullswater, at the Foreign Office on Oct. 12 The conference is the successor of two preliminary meetings, held in 1924 in Sweden and in 1926 in Copenhagen, at which the need of action for the protection of wild ducks, geese, swans, and similar migrants was strongly urged by the representatives of northern European countries. The Governments of the countries concerned were favourably disposed towards the views expressed at the earlier meetings and the invitation of the British Government was accepted by the following Governments, which are officially represented: Germany, Belgium, Holland, Denmark, Sweden, and Finland, as well as Great Britain, with Dr. P. R Lowe and Mr. H S Gladstone as delegates. The discussions of the early sessions of the conference centred round the altered status of migratory wild fowl in recent years Delegate after delegate reported that migratory wild fowl were on the decrease, and this view so impressed the conference that it passed a resolution stating that in its opinion there had been a general diminution in the number of migratory wild towl, and that "in the interests of agriculture, seience, sport, the maintenance of the food supply, and the desirability of retaining natural species of beauty and interest, it is imperative that steps should be taken to arrest such diminution." Various suggestions were made as to means best suited for reaching this end, the extension of the close season, the prohibition of the slaughter of migratory wild fowl on the northward migration to the breeding grounds in spring, the prohibition of mechanically-propelled boats, of clap nets, standing nets, sunk nets, and so on; and the conference blessed them all, and added a resolution recommending the most effective protective instrument of all, that the sale of migratory wild fowl should be forbidden during the close season except under rigid conditions. It will be interesting to see what international legislative action follows upon the unanimous recommendations of the ornithologists.

At the recent International Optical Congress held at Oxford, considerable discussion was devoted to the question of the importance of good vision for all persons licensed as motor drivers. In this matter, keepness of visual acuity is not the only or even the prime consideration, since, when outdoors, one is looking at relatively large objects. The really important things are limitations in the extent of the visual fields, and the further question of binocular vision and latent imbalance of the muscles controlling the eye movements. Limitations in the visual fields do provide a dangerous disability for the driver of any

fast moving vehicle, since whilst his attention is directed straight ahead, he should still be capable and keen to detect the slightest movement (even if associated with some vagueness of form) of any other moving person or vehicle issuing from side streets or lanes into his main sphere of attention, that is, into his central field of vision. With regard to faults in the co-ordinated balance of the two eveswhich would interfere with binocular vision—it is well known that perception of depth and judgment of distance are both almost entirely attained by perfect stereoscopic or binocular vision Any person, therefore, who is deprived of this faculty, is hable to misjudge distances, and there is no doubt many accidents are caused by drivers suffering from such a visual deficiency which led him to believe that he might just clear some imminent obstacle, when in reality the actual distance away from that obstacle was much less than it appeared to be. Such defects are much more dangerous to the rest of the public than the commoner visual defects of long-sightedness or even low degrees of myopia.

ANOTHER question of public interest to which considerable attention was given at the recent International Optical Congress was that of visual efficiency in industry. This is undoubtedly a problem of some complexity, since in British industrial circles there is still some prejudice against the worker wearing spectacles In a great many workshops there is yet the old slubboleth prevailing that the wearing of glasses is a sign of the oncoming of old age, and definitely marks another prospective victim for the human scrap-heap. There is no reason why such a prejudice should still prevail, since it is obvious that the worker will produce better and finer work-with greater accuracy, fewer flaws, and less wastage, if steps are taken to ensure that he is visually efficient was reported that in some large manufactories, schemes had already been brought into operation whereby the eyes of all the workers were examined and any defect was corrected. Statistics prove that in all cases such provision had resulted in a large increase of efficiency in production and increased good health and pleasure on the part of the operative.

A FURTHER point of importance which is regularly overlooked in various trades lies in the fact that many operations are carried out at an abnormally short working distance, and in such cases—even if the operative's sight is perfect for ordinary purposesthere should be some assistance provided in the form of spectacles in order to prevent undue fatigue, headache, and the possible cultivation of more permanent defects. Such a condition of affairs is well illustrated in the process known as 'linking' in the hosiery trade, which was the subject of a special pamphlet recently issued by the government Department of Scientific and Industrial Research. Compared with the United States, there is comparatively little attention devoted to this subject by British employers. The fact that it has been proved by individual firms in such trades as printing, and in such industries as the textile in many of its branches, that both financial advantage and increase of output is a consequence of giving attention to the vision of the worker, it is to be hoped that more general attention will be paid to the question in the immediate future.

WE have already referred to the movement to establish in the Central Reference Library of Southwark a Faraday Memorial Collection, consisting of the biographies, portraits, and published works of Faraday, and the best and latest books on the sciences and their applications, particularly electricity, with which Faraday's name is so closely identified. The Mayor of Southwark mystes contributions to the Faraday Memorial Fund being raised for this purpose The annual meome will be expended year by year under the direction of a special Committee exclusively for the object in view. The use of the Faraday Memorial Collection will not be limited to local residents but, like the benefits of Faraday's discoveries, will be available for all who desire to consult it The memorial is to be mauginated by Sir Oliver Lodge on Oct 28. It is hoped that generous support will be forthcoming to the fund being raised Contributions should be sent to the Mayor, Southwark Town Hall, Walworth Road, London S E. 17. Contributors to the memorial, without regard to the amount subscribed, will be enrolled as foundation

A COMMITTEE to inquire into the organisation, development, and recruitment of the Colonial Vetermary Services has been appointed by the Secretary of State for the Colonies. The committee is asked to frame proposals for obtaining the highest degree of efficiency in regard to vetermary research and administration in the non-self-governing Dependencies that financial considerations permit. The questions to be considered will embrace the recruitment and training of veterinary officers, their conditions of service, the organisation of research and intelligence, the setting up and support of any institutions required, and methods by which the financial expenditure involved can best be met. In framing its recommendations the committee has to bear in mind that the principle of the ultimate creation of a Colonial Scientific and Research Service has been approved by the Colonial Office Conference, and that specific proposals for the formation of an Agricultural Scientific and Research Service for the non-selfgoverning Dependencies, with which the veterinary service must necessarily maintain close liaison, are now being framed. The committee consists of . Lord Lovat (Chairman), the Right Hon. W. Ormsby-Gore, Sir Arnold Theiler, Prof. J. B Buxton, Prof. R T. Leiper, Dr. W. H. Andrews, Dr. J B. Orr, Mr. W. C. Bottomley, and Major R. D. Furse, with the addition of an officer with experience in the Colonial Service. Major G. S. M. Hutchinson, Colonial Office, is secretary to the committee.

In Great Britam, while there are evident the most divergent attitudes towards the problem of birth control, there is no organised attempt to make discussion or propaganda illegal. It is not widely known that in other countries such attempts are being made,

and that in certain countries they have been successful. It may, therefore, be of some interest to give a brief résumé of the position stated in a detailed communication received from Dr. Maile Stopes. The American Coinstock Law was originally designed to prevent the sending by post of indecent pictorial postcards and similar matter. During its progress into law obscene matter was defined so as to include any directions, drugs, or articles for the prevention of conception, and it is now an offence punishable by a 5000 dollar fine, or five years imprisonment or both, to send birth control information by post. The French Law of 1920 is more comprehensive. It punishes by one to six months' imprisonment, and a fine of from 100 to 5000 francs, any one who explains or offers to explain birth control methods, or devotes himself to contraceptive propaganda, or propaganda against childbirth. Similar steps have been taken in other countries The present position, however, is not easy to ascertain, because the measures often assume the form of extending by administrative order the definition of obscene publications, with the result that in certain countries, Belgium and Canada, for example, publications having reference to contraception are seized by post office or custom house officials, or both. A Committee appointed by the Minister of Justice of the Irish Free State recently reported in favour of an amendment of the Indecent Advertisements Act so as to make illegal the sale of literature concerning contraception.

ATTENTION was directed in Nature of July 9 last to the popularly written leaflets on astronomical matters issued by the Astronomical Society of the Pacific. Two further leaflets belonging to the series have now come to hand, bearing the titles "Explormg the Depths of Space" and "The Pons-Winnecke Comet," and others are in course of preparation. In addition, the Society (the address of which is 803 Merchants Exchange Building, San Francisco, Califorma) has, for the last two or three years, arranged series of illustrated popular lectures in San Francisco on various aspects of astronomical research and discovery, delivered by astronomers of repute, to which the public are admitted free of charge. Leaflets contaming syllabuses of the lectures have been issued, at the backs of which are collected useful astronomical data and, in some instances, diagrams of the night sky at various times during the year. During the present session, for example, a series of four lectures will be given by Dr. Wm. F. Meyer, assistant professor of astronomy in the University of California, on the general subject, "From Atom to Island Universe," the titles of the individual lectures being "The Atomic World," "The Interior of a Star," "Island Universes," and "The Night Sky of Winter." An annual visit to the Lick Observatory is conducted by the Society, in connexion with which pamphlets are issued containing information relating to the most interesting objects visible at the time. We hope that a large measure of success will attend these praiseworthy efforts for the popularisation of astronomical knowledge. It is perhaps not generally understood that membership of the Society, including the receipt

of all publications and privileges, is open to all, irrespective of nationality or astronomical qualifications.

The Council of the Iron and Steel Institute has awarded the Carnegie Gold Medal for the year 1925 to Mr A. L Curtis, Westmoor Laboratory, Chatteris, in recognition of his research work on steel moulding sand, etc.

THE Thomas Hawksley lecture of the Institution of Mechanical Engineers, on "Application of X-rays to the Study of the Crystalline Structure of Materials," will be delivered by Sir William Bragg, on Friday, Nov. 4, at 6 o'clock P.M

SIR WILLIAM LARKE, Director of the National Federation of Iron and Steel Manufacturers, has been appointed by Order of Council dated Oct 5, 1927, to be a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

Mr. F. J. Blight, who since 1894 has been associated with the well-known firm of scientific and technical publishers, Messrs Charles Griffin and Co., Ltd., and has been head of that house since 1899, is retiring from that position. Many authors of scientific and technical works published by Messrs Griffin appreciate the valuable services rendered by Mr. Blight to the production of specialised works on important aspects of modern science and industry, and trust that there are still before him turther years of useful life and influence even in his retirement.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A lecturer in building trades and a lecturer in turniture trades in the Technical College, East London, South Africa-The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (Oct 31). A research chemist for work on plasters and other materials used for impressions and models in dentistry—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W I (Nov. 7). An engineer for the Sanitary Department, Buildings and Roads Branch, Government of the Punjab—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, SW1 (Nov. 10) A demonstrator in physiology at St. Bartholomew's Medical College-The Dean, Medical College, St. Bartholomew's Hospital, E.C.1 (Nov. 16) A chief lecturer in chemistry at the Woolwich Polytechnic-The Principal, Woolwich Polytechnic, SE 18. A naval architect for the Marine department of the Government of Nigeria-The Crown Agents for the Colonies, 4 Millbank, S.W 1 (quoting M/6) A junior technical officer in an Admiralty experimental establishment, mainly for experiment and design in connexion with wireless and other electrical apparatus — The Secretary of the Admiralty (CE. Branch), Whitehall, S.W.1 principal of the Massey Agricultural College, New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2.

### Our Astronomical Column.

Magnetic 'Storm' and Sunspots —On Oct 12, at  $10\frac{1}{2}^h$ , a considerable magnetic disturbance commenced and lasted until  $2^h$  on the following morning. The chief characteristics as shown by the declination magnetograph records at Greenwich were, first, the sudden commencement; and secondly, the occurrence between  $18^h$  and  $21^h$  of three distinct waves of magnitude about 30', 25', and 40' respectively. The total range in declination throughout the disturbance was about  $1^\circ$ . A lesser disturbance, of interest on account of its sharp commencement, also took place between Oct 9,  $20\frac{1}{2}^h$  and Oct 10,  $23^h$ 

At the time of the phenomena there were three groups of sunspots within a short distance of the sun's central meridian, as follows.

	Central Mendian Passage	Latitude.	Area on Oct. 9	
l.	Oct. 9.4	19° N	300, Millionths of	:
$^2$ .	Oct 10 6	12 S	500 sun's hemi-	
3.	Oct. 116	19 S	250) sphere.	

Both (2) and (3) were returns of large groups, conspicuous in the previous rotation, to which attention was directed in Nature of Sept. 24, p. 456. A large area of bright faculæ surrounded these two groups of which (2) showed marked changes after Oct 7, when new spots appeared. A connexion may reasonably be attributed between this group of spots and the magnetic 'storm' of Oct. 12.

METEOR SHOWER OF (HACOBINI'S COMET.—Mr. W. F. Denning writes that "two observers watched the sky from Bristol on Oct 8, 9, and 10 from about 6.30 p.m. to 9.30 p.m., though the moon was near the full and some fog prevailed. The object was to

observe a few meteors from Gacobini's comet, the orbit of which hes near the earth's path on Oct. 9-10. It may be remembered that last year a definite shower was witnessed on Oct. 9 with a radiant agreeing with that computed for the comet named. Owing to the unfavourable conditions, tew meteors were noticed this year, but on Oct. 8 about eight were seen and ten on Oct. 9. A fine flashing meteor was seen on Oct. 8 at 7.56 PM. in the south-west, but it could have had no association with Giacobini's comet. On Oct. 9 seven meteors were recorded, which showed diffuse radiation from 260° + 53°, and there is little doubt that this shower represented a return of the display of 1926, as the date agrees and the position of radiation, in the head of Draco, nearly coincides. No doubt the display would have been more abundant and the individual objects more brilliant but for the fog and moonlight which made the circumstances extremely unfavourable."

Photometry of the Moon's Surface.—Astr. Nach. No 5524 contains observations of the albedo of various regions of the moon, made by A. Markov at Pulkovo. The observations were photographic on Agta plates. Photographs of stars and of a standard lamp were taken for comparison. Aristarchus is the region of highest albedo, the value being 0 37, Tycho and Proclus coming next. It will be noticed that the value is far below that for snow, which some had suggested as possibly present on the brighter regions. The darkest regions are Schickard and Grimaldi with values 0 09 and 0.07. The mean albedo of the disc is about 0.16, in good agreement with former determinations.

## Research Items.

CAVE EXPLORATION AT LESPUGUE, FRANCE.-Cultural and chronological relations of some importance have been established by excavations in the Grotte de Gouerris at Lespugue, which have been carried out by M. le Comte de Saint Périer, and are described by him in L'Anthropologie, T. 37, Nos. 3-4. The cave was first discovered by Miss D. Garrod. When excavated it was found to contain three levels of occupation. Of these the latest was neolithic, when the cave was not used as a dwelling-place but solely for purposes of burnal. Traces of fire have been discovered, which probably points to the preparation of funeral feasts in the cave. No signs of the habitation-sites of the people using the cave for burial purposes have been found in the neighbourhood. Of the two preceding occupation levels, the earliest was that of a palæolithic people, who, it is suggested, made no prolonged stay. Probably they were hunters following the herds of reindeer of which the remains are abundant. They belonged to an early stage of the Magdalenian epoch when the harpoon was still unknown. They appear to have been related to the population of Perigord rather than that of the Pyrenees. After a period which allowed of a considerable deposit of stalagmite, they were followed by a people of low culture. The climate by then had become warmer and more moist. This people, as is indicated by their culture, belonged to the very beginning of the transition period. There are many Magdaleman types of implement. The harpoons are not of the typical Magdaleman style, yet they have not yet attained the Azilian form with teeth on both edges. A comparison with Mas d'Azil establishes the position of this culture as between the latest Magdalenian stratum at Mas d'Azil (Couche D of Piette) and the stratum E in which the coloured pebbles and the full-fledged Azılıan culture were found. Thus Piette's contention that the large flat harpoon with unilateral barbs belonged to quite the beginning of the transition period is not only supported but also is given greater precision in date.

CRIMINAL STATISTICS.—Statistics relating to criminal proceedings, police, coroners, prisons, and criminal lunatics for the year 1925, have recently been published (London: H.M. Stationery Office. 4s. net). Not only are the actual figures given for the period surveyed, but also comparative tables and graphs, so that the 'peak' periods and the variations at different periods can be studied. Allowance has of course to be made for the increase in population by about seven millions since 1899: it is suggested that the safer figure for comparative purposes is the proportion the indictable offences known to the police have borne to every 100,000 of the estimated population. crime rate would seem to have fallen since 1857: for the period since 1899 the worst year is 1908. Here would appear to be reflected the effect of the Boer War. Six years after this war the increase in indictable offences was checked, and it is hoped that the similar increase since the War of 1914-18 will also be arrested. While there has been a tendency for the number of homicides to decrease in number, crimes against property, i.e. burglary, etc., have increased during the period 1899–1925. The volume will be of very great service to all those interested in social conditions, as well as to those officially concerned with the problems involved.

QUANTITATIVE METHODS IN GEOGRAPHY.—In an attempt to test and compare the intelligence of communities, Prof. E. Huntington has utilised the census figures showing the number of persons of

various ages in the American States. Arguing that these figures should show a steady decrease from one upwards and so be represented, when plotted, by a smooth curve, he shows that the curves are extremely irregular in many of the States where negroes are numerous. This he maintains is due to carelessness or ignorance The age of the children is forgotten or merely stated in a round figure in order to save trouble. Soveral of these curves are produced in an article in the Scientific Monthly for October entitled "The Quantitative Phases of Human Geography." Prof Huntington has also compiled a map of the United States showing accuracy of census returns as to age based only on native whites of native parentage in order to eliminate, so far as possible, questions of race. This map shows the highest degree of accuracy in the northern States, with a steady falling off towards the south and especially the south-east, except for Florida, where recent migration from northern States has been marked In Nevada the standard is low, probably due to the decay of the mining industry and the drifting away of the more intelligent classes. The paper also contains other maps compiled from census statistics.

LIMNOLOGY IN CALIFORNIA.—The region in which Stanford University lies, the Santa Clara Valley, California, owing to its brief rainy season, is dependent throughout the summer on irrigation. university supply is from a small artificial reservoir I mile long and I mile wide, the Scarsville Lake. Dr. Flora M. Scott has recently carried out a proliminary survey of this lake ("Introduction to the Limnology of Searsville Lake," Stanford University Publications, University Series, Biol. Sci., vol. 5, No 1, 1927, pp. 1-83). According to Whipple's classification, this is a 'tropical' lake, the surface temperature never falling below 4° C. The greatest depth does not exceed 7 m., and circulation is therefore ensured. The plankton content is, however, temperate in character and shows a seasonal rotation of sub-arctic to sub-tropical forms in the course of the year. The Bacillaries as a group culminate in the spring, the Chlorophycee and Cyanophycee give rise to the summer maximum, while flagellates persist throughout the entire season. In the summer of 1924 the level of the lake became so low that the fish died off, and for hygienic reasons the lake had to be drained. Opportunity was then taken of carrying out some culture experiments with the dry surface mud from the lake bottom. If the solutions were kept acid (pH 5) no plankton organisms could be cultured from the mud samples, but under alkaline conditions the plankton soon became abundant. When the cultures were maintained at a temperature of approximately 34°C., the blue-green alga Oscillatoria alone succeeded in thriving.

Fresh Water Biology in Norway. In 1905 the Academy of Science in Oslo received, by will, an estate from Herrn Direktor F. O. Guldberg on condition that a biological research station was set up. The first ann was by means of farming to secure a fund; and in 1925 sufficient had accumulated to buy a property on the Hurdals-See for which a boat-house, motor-boat, etc., were provided. In a recent report Prof. H. H. Gran and Miss Birgithe Ruud give some preliminary results ("Über die Planktonproduktion im Hurdals-See," Vidensk Acad. Oslo I. Mat-Naturvid. Klasse, 1927, No 1, pp 1-33). The Hurdals-See is a lake of average depth and of the type with stagnation in the bottom water in summer

and winter, and vertical circulation to the bottom in spring (May) and autumn (November) The discontimuity layer lies in summer between 10 m. and 25 m. Lowering leaves of Ranunculus aquatilis peltatus in bottles to different depths, and noting the oxygen exchange, showed that the point at which assimilation equalled respiration lay between 6 m and 8 m. For diatoms and brown flagellates this depth was greater. Quantitative investigations of the centrifuge plankton showed that whereas the flagellate Dinobryon sertularia had a summer maximum in June, all other species increased slowly throughout summer, reaching a maximum in September. The chief forms were Tabellaria fenestrata, Cyclotella comta, Melosira distans, and Staurastrum jaculiferum. As regards quantity of phytoplankton, the Hurdals-See does not differ essentially from most lakes in central Norway according to Naumann's designation, an 'oligotroph'

AMPHIOXUS.—Dr. V Franz of Jena has given in "Die Tierwelt der Nord- und Ostsee" (Leipzig: Akademische Verlagsgesellschatt, 1927, Lieferung 8, Teil XII b, "Branchiostoma") an account of Amphioxus which is a beautiful little monograph in itself Branchiostoma lanceolatum, as Amphioxus is now called, is the only European representative of the class Acrania, which altogether includes about a dozen species. This is, however, the only really well-known form which both on account of its primitive vertebrate character and its comparative accessibility is beloved of all zoologists, and an enormous amount of literature has been amassed dealing with this single animal. From the collection Dr Franz has sitted out the interesting and important, and made a most useful summary, anatomical, embryological, and physiological. He is well equipped for undertaking such a work, as he has himself made considerable contributions during the last few years to the minute anatomy and behaviour of Amphioxus, including studies of the methods of movement, reactions to light and researches on the sense organs and sense cells.

THE LUNG-WORM AND THE STOMACH-WORM OF THE Cat.—Dr. T. W M. Cameron (Jour. of Helminthology, June 1927) has investigated the life history of the lung-worm and of the stomach-worm of the cat The former, Elurostrongylus abstrusus, lays its eggs in the alveoli and in the pareschymatous tissue of the lungs and there the larvæ hatch, pass up the trachea, are swallowed and pass out with the fæces. A description is given of the morphology and biology of the larva. When infected faces are eaten by mice the larvæ migrate from the stomach of the mouse to the muscles and subcutaneous tissue where they encyst, and within three weeks develop into the infective stage, which may remain viable in the muscles for at least a year. If an infected mouse is eaten by a cat the larvæ escape from their cysts, reach the lungs, and within six weeks become mature adults. stomach worm, Ollulanus tricuspis, lives on the surface of the gastric mucosa and in the acini of the The first-stage larva emerges from the egg in the uterus of the worm and moults there. second-stage larva develops into the third-stage larva which is found outside the parent worm, but the exact period at which it left the parent was not determined. This larva leaves the stomach of the cat in the vomit (and possibly in other ways, though no other has been discovered) and is swallowed by a new host in which it develops into the fourth-stage larva and finally into the adult. The characters of these four larval stages are described and figured. Hitherto it has generally been accepted that Ollulanus tricuspis had a complex life history requiring an intermediate host—the mouse. This view arose through the confusion of the larvæ of Ollulanus and Elurostrongylus Leuckart found larvæ in the cat and the mouse which he believed to be those of Ollulanus, but they were really larvæ of Elurostrongylus.

THE BORING UNIONID OF ASSAM.—The distribution and habits of the remarkable boring unionid, at first referred in 1836 to the genus Anodonta, but now known as Balwantia soleniformis (Benson), have lately received the attention of Dr Sunder Lal Hora (Jour. Proc Asiatic Soc Bengal, vol. 21) retiring habits it has been greatly overlooked, but Dr Lal Hora is confident that it will prove widely distributed in South Cachar and several other places in the Surma valley. The animal lives in inclined burrows excavated in hard blue clay or in finable sandstone, after the manner of marine boing molluscs. The burrow is of uniform calibre throughout and its cross section corresponds with that of the shell, but is a little larger, while its length is about two inches The bivalve is anchored to the far end of the burrow by its foot, by the expansion and contraction of which it can move to and fro in the burrow, and thus by the aid of the coarse ridges on the shell enlarge its tenement at will There is no proof that the young animal starts a burrow de novo. it probably takes possession of some pre-existing hole or crack and enlarges it as required. The molluse is considered a great delicacy by the Uriya coolles, who have an ingenious way, that is fully described, of extracting it from its crypt

Afforestation in Michigan —Those interested in the afforestation work proceeding in Britain should read the Special Bulletin (No. 163, June 1927) on "Forest Planting in Michigan" by Alfred K. Chittenden of the Michigan State College of Agriculture. Planting work experiments have apparently been undertaken during the past thirty years at this institution. The present-day problem of the United States in connexion with timber supplies is well known and has been alluded to in NATURE on several occasions during the past year. The position of the several individual States in the matter is therefore not without considerable interest in Europe The author writes, "One of Michigan's greatest problems is that of replacing her forests. This is becoming increasingly important as the timber of the United States as a whole is being Nature, he says, if given a chance will restore the forests of her own accord, but this is a slow process; nor will the composition of the second growth consist of the most valuable species. If these latter are required, planting must be resorted to. The author regards the matter from a different view-point to that usually accepted in Europe. "Although trees," he says, "will grow on the poorest soils, they, like farm crops, will do better on richer soils. So, while the forests will probably ultimately be confined to the poorer classes of soils which will not be needed for agriculture, it is better to plant forests in the meanwhile on the best lands available for the purpose.' This may be the correct solution at the present time in a country where extensive areas of land are available, but would scarcely be applicable in England where the growth of food crops on all lands of suitable quality must be a first desideratum. The brochure is mainly confined to and intended for the planting of wood lots on farms. In several sections it deals with the questions of raising trees from seed in the nursery, the season to plant, field planting with costs, soil requirements, and the suitable species to make use of both from the point of view of soils and the uses to which the material grown can be put. Brief descriptions of the species advocated are given. The Bulletin

concludes with a note on the afforestation of sand dunes and the method of planting windbreaks and shelter-belts.

New Eocene Mollusca from Texas —An interesting paper on some new species of Mollusca from the Claiborne and Wilcox groups of the Eocene of Texas comes from the pen of Julia Gardner (Jour Washington Acad. Sci., vol. 17). Twenty-one new species and subspecies are described and figured on four excellent plates. The only freshwater form recorded belongs to the genus Planorbis, which has not been previously reported from the Eocene of Texas, and is represented by P. anderson, n. sp. It is fairly common at the single locality where it was found

New Silurian Pelecypod (Pycnodesma) from Alaska — Mr. Edwin Kirk places on secord a new pelecypod genus. Pycnodesma, from the Upper Silurian of Alaska (Proc. U.S. Nat. Mus., vol. 71, art. 20) It is a large massive shell, sometimes attaining a size of 12 inches across and upwards of 2 inches in thickness at the umbonal region. The author refers it to the Megalodontidæ and compares it with Megalodon and Megalomus, from both of which it differs in its hinge characters. His figure of the hinge shows its peculiar features, which are such as to raise the question whether, possibly, this new genus may not be an ancestral form of his earlier described Devonian Tanaodon (Nature, vol. 120, July 2, 1927, p. 25), although the author himself does not make the comparison.

DISCHARGE PHENOMENA.—Important quantitative contributions to the theory of glow discharges have been made by Prof. K. T. Compton and Mr. Morse in the September number of the Physical Review, and by Dr. J. Taylor in an Utrecht thesis presented on Sept. 28. The former have deduced a relation between the cathode constants of a discharge which is just self-maintained, and Prof. Townsend's 'ionization constants' for the gas. The new feature in their work is the use of the principle that the fields within the tube must be distributed so that there shall be a minimum dissipation of energy; Poisson's space-charge equation does not occur in the main analysis. Their predictions are verified as well as can be expected from the present meagre experimental data. Dr. Taylor has been more concerned with the initiation of the discharge, where he has been able to correlate the sparking potentials with the normal current-voltage curves, and those obtained when the supply of energy is restricted externally.

Stereographic Survey.—In the Geographical Journal for September, Major K. Mason describes, with maps, the results of his experiments in the Shaksgam with the Wild photo-theodolite. The instrument proved most satisfactory and the criticisms that are offered refer only to minor points of design and very superficial matters. The tests included an area already within the planetable survey of India, an area at the edge of the survey, to ascertain the value of the instrument for long distance reconnaissance survey, and an area without any control points identified for certain to find the limitations of the method for the revision of old maps. The plotting of the photographs was done on the Wild Autograph, which is designed to plot and contour four pairs of plates taken with the phototheodolite. Mr. A. R. Hinks describes this machine and explains its principles in the same issue. The method has proved so successful that the Swiss Federal Topographical Survey has decided to use it in the re-survey of the whole of Switzerland.

MEASURING QUARTZ FIBRES.—In the October issue of the Journal of Scientific Instruments, Messrs G. A. Tomlinson and H. Barrel, of the National Physical Laboratory, describe the two methods they have used for measuring the diameters of fine quartz fibres. If the fibre is placed in a parallel beam of white light and the deviations of the coloured bands seen on each side of the fibre are measured, then, on the theory that the fibre acts as a slit, its diameter can be calculated. Owing to reflection and refraction at the fibre, the results are not very accurate, but the method provides a simple means of testing the uniformity of the fibre by observing the bands as the fibre is moved along parallel to itself. The more trustworthy method is to clamp the ends of the fibre so that it is horizontal, and to hang a weight of about a milligram to its centre and measure the sag The elasticity of quartz is taken as  $5.18\times10^{11}$  dynes per sq cm. The arrangement is that adopted to determine the breaking stress in wires by s'Gravesande, Physices Elementa Mathematica " (1742)

A MECHANICAL MAXWELL DEMON.—Small particles are notoriously more difficult to examine when they are neutral than when they are charged, and although the distribution of velocities amongst groups of electrons and ions has been analysed frequently, it has hitherto been impracticable to do this satisfactorily for ordinary gas-molecules. A considerable advance in this direction is described by J. L. Costa, H. D. Smyth, and K. T. Compton in a recent paper in the Physical Review (vol. 30, p. 349). A shaft carrying two slotted wheels was rotated at high speed within a stout metal container, the space between the wheels being evacuated by a powerful diffusion pump. (las was fed into a lateral chamber, and those molecules the velocity of which had the appropriate relation to the speed of rotation and to the geometry of the apparatus, passed through gaps in both wheels and fell on the vane of a delicate radiometer. When the deflexion of the latter was plotted as a function of the rate of revolution, curves were obtained which agreed with those predicted on the assumption that the molecules had a Maxwellian distribution of velocities. The experiments were, however, difficult- in particular, the radiometer had to be used almost at the limit of its sensitivity—and it is unfortunately not yet possible to obtain the 'velocity spectrum' which was the original aim of the investigation.

THE IGNITION OF GASES BY HOT WIRES.—A recent publication (Paper No. 36) of the Safety in Mines Research Board (London: H.M. Stationery Office, 1927. Is. net) contains an account of a research carried out to discover whether the glowing filament of a two-volt miner's electric lamp-bulb might cause the ignition of mixtures of firedamp and air and thus constitute a source of danger in a coal-mino. The tungsten filaments of bulbs of recent manufacture burn at a high temperature (about 1500° C.) and, if breaking the glass did not fracture the filament, were found capable of igniting mixtures containing not more than about 12 per cent. of methane. With more than about 12 per cent. of methane. platinum wire of a given diameter, ignition can only occur within a narrow range of current, below which flameless surface combustion takes place. Above this limit, the wire fuses without igniting the mixture, providing it is less than 0.1 mm. in diameter. Heated tungsten wire, however, oxidises rapidly in the presence of oxygen, the temperature increasing until the metal burns with a bright flame of short duration but high temperature. This flame causes the ignition of firedamp. It is therefore recommended that the lamps should incorporate an automatic circuit-breaker operated by breaking the outer protecting glass.

# The University of Bristol.

NEW PHYSICS LABORATORY

THE University of Bristol not only owes its foundation to a member of the family of Wills. but also has since received a series of princely gifts from his two sons, Sir George and the late Mr. Henry Herbert Wills Of these none is more striking than the Henry Herbert Wills Physics Laboratory, formally opened on Oct 21 by Sir Ernest Rutherford before a distinguished company of physicists and of supporters of the University in Bristol and the surrounding counties. The laboratory through which Bristol may be expected to become increasingly important as a centre of physical research and teaching has arisen as the result of a gift of £200,000 presented in the years of future extension; pending this, an external non staircase is provided at its end. It contains four floors, together with one large and one small cellar completely underground In general the 100ms are arranged in units or multiples of units, in width 17 feet between centres. On the north side of the corridors most of the rooms are 26 feet deep, and on the south side 161 feet deep. The ferro-concrete floors have intermediate support on a single row of concrete pillars axially central in the building. The building is designed more or less as a shell, and internal divisions may be removed or rearranged as required.

The general scheme of this portion of the building

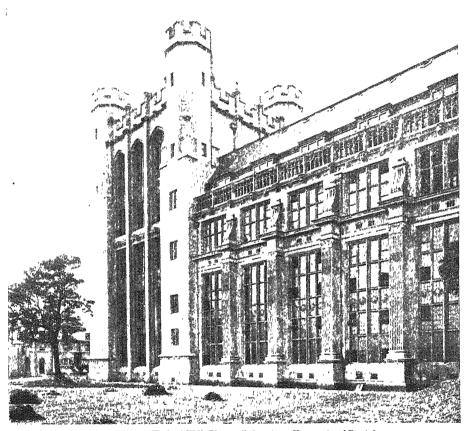


Fig. 1—Henry Herbert Wills Physics Laboratory, University of Bristol.

1919-20. Mr. Wills desired that this gift should be used mainly in the erection of the building and that the interest accruing in the meantime should provide for its scientific equipment and go towards the establishment of an endowment fund for its maintenance.

The building as designed is the first instalment of an extensive scheme of University buildings intended by the donor to crown the top of a hill overlooking the city, and to be a distinctive feature in distant views of the city. Until the whole scheme has been developed, either as Mr. Wills intended or on somewhat similar lines, the meaning of the design of this first unit, with its tower and reversed "L" shaped plan, cannot be fully grasped.

The long arm of the "L" is arranged with the view

is subject to alteration in later years as the work of the laboratory develops. At present it is as follows:

Ground Floor ... Research Rooms, Power Rooms, and Workshop.

... Research Rooms and Senior Teach-First Floor ing Laboratories.

Senior Optics and Junior Teaching Second Floor Laboratories.

... Library, a suite of Class Rooms, Third Floor Seminars, and Private Rooms.

On each floor one or more rooms are allotted for future extension and fittings are not yet provided; the necessary supplies are, however, brought to the rooms ready for distribution later as required. In particular, on the third floor advantage is being taken of space set aside in this way to maintain a close haison with the Department of Mathematics, which, it is anticipated, will occupy the greater part of this floor for some years to the mutual benefit of both subjects. On this floor a room 53½ by 26 feet, with a gallery, is allotted to the library, and will provide accommodation for many years for the growing needs of the two departments in this direction

An important bequest by Mr John Exley to the University College of Bristol in 1900 has provided the library with valuable sets of back numbers of leading scientific periodicals. The supply of these has since been maintained by annual grants which will be supplemented, owing to Council's decision to allocate to the Physics Library the income from a capital sum of about £1800 bequeathed to the University by

Miss Maria Mercer.

The short arm of the "L" contains two storeys, and includes two theatres, apparatus rooms, and cloak rooms. The larger theatre, on the first floor, contains seating for 300 as a minimum, but bench seats provide for a considerably larger audience on special occasions. Its blinds are electrically controlled. The smaller theatre is beneath it, and is provided with a minimum seating of 130. The acoustic properties of both theatres have received particular consideration.

Under the roof of each arm of the building there is a large loft suitable for extensive storage or, if need be, for any special experiment requiring an uninterrupted

length of space.

The junction of the two arms of the building is surmounted by a tower 64 feet square—In this there is a fourth floor containing two large rooms available for research. It is flanked by four turrets, one of which contains a vertical shaft. 4 feet by 3 feet, which goes to the bottom of the building, 90 feet below

In the general equipment of the rooms special regard has been paid to the wishes of the donor that the furniture and fittings should be of such a high quality as would relieve the University from expenses of repairs for many years to come. The changing needs of any scientific laboratory in these days of rapid advance have, however, been constantly kept in mind, and nothing has been done to diminish the flexibility of the equipment essential to meet new conditions as required. In the provision of gas, water,

and electricity in the various rooms the rival claims of the overhead system and the floorduct system have been carefully considered. It was telt that in the main teaching laboratories, where the presence of a few fixed tables distributed over the floor has no meonvenience, the floorduct system has fewer disadvantages, and for this reason it has been adopted. In the research rooms, many of which are relatively small, the supplies of gas, water, and alternating current are conveyed through the rooms in floorducts, and those of direct current of various voltages by bare wires overhead At the same time, a horizontal duct with creeping way is provided in the roof of the main corndors. This not only serves the purpose of a vitiated air duct in the ventilation system, but also gives means for rapidly laying any temporary cable or piping as required to any room

For the supply of compressed air and of vacuum, the unit system has been preferred to that of general distribution. Any worker who requires either of

them has it thus under his own control.

The University Council has been fully alive to the necessity for funds for apparatus and for additional personnel. It has, however, aimed at avoiding the inistake of installing special equipment of a costly character before men are available to use it, and equally that of creating a number of new posts before funds are available for the provision of the apparatus necessary for their investigations. In apparatus, therefore, immediate provision has been made for the researches of the existing staff, and for the present requirements in teaching, while a small reserve fund has been set aside to form a nucleus for future needs

In the provision of personnel the Council has found its way to meet some of the new requirements by the creation of certain new posts. Thus, as has been already announced in these columns, Dr. J. E. Lennard-Jones has been appointed to a professorship in theoretical physics and Dr. L. C. Jackson and Dr. H. W. B. Skinner to Henry Herbert Wills' research fellowships.

If, however, the laboratory is to be put to the full uses that its donor desired, further additions to the personnel and equipment will be necessary, and it is hoped that both will soon be forthcoming.

# The Velocity of Light.

By M. E. J. GHEURY DE BRAY.

MOST tables of determinations of the velocity of light contain misstatements which seriously detract from their utility. Moreover, there seems to be no table available giving a fairly complete summary of the work which has been done to ascertain the exact value of this most important constant.

The following table has been compiled, from the original communications contributed by the investigators themselves, for the purpose of meeting this want. It contains every value which has been deemed by the author of the observations to be worthy of being stated as the result of a completed series of experiments, in the course of the work which ultimately led to a final value adopted as representing best the result of this work.

The history of the quest for the value of the velocity of light is conveniently divided into three periods, and the table has been accordingly divided into three sections, in a manner which the headings render self-explanatory.

The letters TW refer to the toothed wheel (or 'eclipse') method and RM to the revolving mirror method. These two methods which, although both

of French origin, have become characteristic of European and American practice respectively, are classical and need no further explanation here. References to the original papers, etc., are given after the table, with brief remarks whore necessary. In most cases the data have been left in the form in which they were given by the investigator or by the author of the paper, etc., himself (except that all the values of the velocity have been expressed in the same unit: kilometres per second), even when a modification suggested itself, such as when the velocity in air only was given, or when the velocity was stated with a degree of accuracy which is evidently unwarranted owing to the residual uncertainty attaching to the determination.

Not infrequently it has been impossible to ascertain the average date of a series of experiments, and in such cases, after careful consideration of the available evidence, a date has been adopted which appears to represent fairly the most probable position of the observations on the chronological scale. The values being tabulated in chronological order, it follows that mean values (to which a mean date has been assigned)

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are placed in the table before some of the determinations concurring in its formation. The determination of a velocity being dependent on the value of the unit of time, and the latter being determined by the time of rotation of the earth, which is suspected of variation, it is thought that the exact date may become useful in the view of further advance in knowledge, and it is desired that the table be no more found wanting in this respect than in others.

It is seen from the table that there are seven, and only seven, determinations which may be considered

as trustworthy.

(In the discussion below, the abbreviated references are to publications listed at the end of this article)

not stated. Harkness also gives as Foucault's value 298,574±204, stating that this is the final result obtained from 80 observations made on Sept 16, 18 and 21, 1862. This information is derived from the "Recueil des Travaux Scientifiques de Léon Foucault," Paris, 1878, which gives (pp. 224 and 225) the dates and numerical results of Foucault's observations on the velocity of light, made between May 22 and Sept. 21. The value still given in this "Recueil," however, is the same as that given in the Comptes rendus, namely, "298,000 kilometres par seconde de temps," and it is not apparent how the value given by Harkness is obtained from the data given in the 'Recueil."

N	0	Average date	Investigator.	Method	Length of base	Base	Velocity, km /sec	Medium	Remarks
i					FIRST PE	RIOD PIONEER EXPERIMENT	rs		
1	$\begin{array}{c c}1\\2\end{array}$	1849 5 1862 8	Fizeau Foucau	$_{\mathrm{RM}}^{\mathrm{rW}}$	8,633 m, 20 m	Sure-nes—Montmartre Paris Observatory	$315,300 \\ 298,000 \pm 500$	Air ,	
					SECOND PERIOR	CHIEFLY WITH SHORT BE	ASES		
:	3	1872 0	Cornu (a)	TW	10,310 m	Ecole Polytechnique— Mont Valérien	$298,500 \pm 300$	Air	Preliminary value (rejected as doubt-
į.	1	1874 8	,, (b)	,,	22,910 m	Paris Observatory— Montlhery	300,400 ± 300	Vae	ful)
1	5	,,	Cornu-Helmert	,,	,,	Monumery ,,	$299,990 \pm 200$	٠,	Cornu's results dis- cussed by Helmert
	6	1878 0	Michelson (a)	RM	1986 23 ft	U S Naval Academy	300,140 ± 300	,,	Preliminary value (discarded)
	7 8	1879 5 1880 9	(b) Newcomb (a)	,,	2550'9 m	Fort Meyer—US Naval	<b>299,910</b> ± <b>50</b> 299,627	ii.	Corrected value Doubtiul
	9	1881 0	Young and Forbes	тw	(18,212 2 tt and 16,835 0 ft	Wemyss Bay—Hills behind Innellan	301,382	Vac {	Admittedly unre- liable
1	9	1881 7	Newcomb (b)	RM	3721 2 m	Fort Meyer—Washington Monument	299,691	Air	Doubtful
1	1	1881 8	,, ( <i>t</i> )	,,			299,810	Vac	Mean of $(a)$ , $(b)$ , and $(d)$ .
1	2	1882 7	,, (d)	,,	3721-2 m.	Fort Meyer—Washington Monument	299,860 + 30	,,	Final declared value
1	3	1882 8	Michelson (c)	,,	2049 532 ft	Cave School of Applied Science, Cleveland	299,853 1 60	,	
ĺ					THIRD PERI	OD. WITH VERY LONG BAS	ES		
1	4	1900 4	Perrotin (a)	TW	11,862 2 m	Nice Observatory—La Gaude	$299,900\pm80$	Vae	Piehminary discus- sion (superseded)
1	5	1900 4	,, (b)	,,	77	raude ,,	$300,\!032 \pm 215$	,,	Final discussion (dis- carded)
1	.6	1901 4	,, (c)	,,	_	_	$299,\!880\pm50$	,,	Mean of (a) and (d) (superseded)
1	7	1902 1	,, (d)	,	45,950·7 m	Nice Observatory—Mont Vinaigre	$299,860 \pm 80$	,,	Preliminary discus- sion (superseded)
1	18	1902 4	,, (e)	,,	,,	vinaigre ,,	$299,901 \pm 84$	,,	Perrotin's final de- clared value
1	19	1921-6	Michelson (d)	RM	35,385 53 m	Mt Wilson Observatory— Mt St Antonio	299,802 ± 30	,,	Preliminary (cor-
2	20	1926 0	,, (e)	,,	73	,,	299,796 ± 4	,,	- 50000, 10110
2	21	In progress	" (f)	,,	About 131 km.	Mt Wilson Observatory— Mt San Jacinto	Not yet published	,,	

(1) [1, vol. 29, 1849, p. 90] and (2) [1, vol. 55, 1862, p. 501] are admittedly but rough approximations, the experiments being intended to ascertain the possibilities of the method. The unreliability of the second determination may be estimated from the fact that the deflexion from which it was deduced was only 0.7 millimetres (ii, p. 233). The first result is undoubtedly far too high, and the second is much too low. There appears to be little to choose between the two, although the second method is more likely to be the less maccurate, being simpler in technique and of easier application. One seems justified in taking their mean.

W. Harkness (Washington Observations for 1885, Appendix III. p. 29, under the heading "Velocity of Light in racuo," gives as being Fizeau's value "70,948 lieus (sic) of 25 to a degree = 315,324 kilometres." The former value is not the value in vacuo, and how the equivalent in kilometres was obtained is

(3) [111, p. A 298, footnote] was rejected by Cornu as being affected by serious systematic errors

(4) [in and i, vol. 79, 1874, p. 1361]. In the Annales (p. A 293) the velocity is given as 300,350 in air, the additive correction to vacuum being 82; the final velocity is 300,400. In the Comptes rendus (p. 1363) the velocity in air is given as 300,330, and the final velocity in vacuum, obtained by multiplying by 1.0003, is 300,400. Cornu, therefore, evidently concerns himself with four significant figures only. Newcomb [vib, p. 202] gives wrong years for these determinations, and the errors are copied (xi) by Michelson and Preston ("The Theory of Light," 1901 ed., p. 511).

(5) [iv, vol. 87, 1876, col. 123]. Cornu protests strongly against the treatment his results have suffered in Helmert's hands [ii, p. 227, footnote]. The probable error is estimated by Todd

[v, p. 61].

(6) and (7)  $[v_1a]$  The first value was discarded by its author owing to its large probable error (loc cit., pp. 115-116) compared with the greater accuracy of the subsequent determination. The latter was given as 299.944 - 51, and rounded to 299.940 = 50 (loc. cit, p 141). A correction was announced later on [vic. p 244], reducing it to 299,910 - 50. Newcomb, when mentioning this correction, misquotes the original value, giving it as 299,942 [vib, p 119, footnote]. Todd [v, p. 61] refers to this value as given in the 'corrected slip,' but gives 299,930, no confirmation could be found

(8) and (9) [vib] are declared by Newcomb to be doubtful owing to the presence of systematic errors. "The preceding investigations and discussions seem to show that our results should depend entirely on the measures of 1882" (loc. cit., p. 201). He does not trouble to reduce them to vacuum, and he does not mention their probable errors. It is only with evident reluctance, and to avoid criticism (loc. cit, p. 201-2), that he includes them in a mean value (11), with (12) which is clearly the value which he favours

as most reliable (loc. cit, p. 202)

(9) [vii, p 231]. Two distant reflectors, in line with the source of light at the observing station, were used so as to have two images. Other experimental features, however, were detrimental to the obtainment of good results, and this determination was severely criticised by Newcomb [vi b, p. 119] and by Cornu [ii, p. 229]. The result is given by the authors with an unwarranted accuracy (loc. cit., p. 269), but they give no probable error.

(13) [vi c]. The agreement between this value and Newcomb's last determination (d), obtained practically simultaneously, is worthy of remark; it seems to show that the accuracy was greater than the probable errors

seem to indicate

(14) [i, vol. 131, 1900, p. 731], and (17) [i, vol. 135, 1902, p. 881] were evidently announced as soon as a preliminary reduction had been carried out. Their average (16) is given in the second communication (p. 883), and is generally quoted as Perrotin's final value, although these results were considerably modified in the course of the final discussion (vide infra, (15)

and (18)).

(15) and (18) [viii]. Incredible as it may seem, this final discussion of the experiments first reported in the Comptes rendus (vide supra, (14) and (17)), makes no mention whatever of the results mentioned in these first communications. It is necessary to compare the observations themselves in order to ascertain that (a) and (b) are deduced from the same first series of observations, while (d) and (e) are deduced from the second series. The confusion is increased by the fact that (e) is so nearly identical with (a) that the latter seems to be the former rounded off, while they are actually obtained from two different series of observations over different bases. Prof. Michelson did not avoid this pitfall, and quoted Perrotin's final result as having been obtained over the shorter base instead of the longer one [x and xiii].

(19) [ix a, p. 256] was first given as 299,820, but a correction given later on [ix b, p. 2] reduced it to 299,802. It is given separately here, although, ultimately, it was 'lumped up' with others to obtain a mean, because it was evidently deemed by its author to be of sufficient accuracy to be published at once, which was not the case with any other pre-

liminary results obtained before.

(20) [1x b, p. 1] is the most accurate value yet published. It is the average of several series of observations made with multi-facet mirrors, all of which are in agreement within  $\pm 1$  km./sec.

(21) [ix b, p. 12] is announced as being in progress;

the base is the longest ever used, Perrotin Intherto holding the record. It is expected to be accurate to within I kin /sec

The following values have also been mentioned by certain authorities, no confirmation having been

obtamable

(22) [x and xiii] In the "table of results of the more important investigations to date," Prof Michelson gives for his own results (presumably from the observations made in 1878-1882) the value 299,895. It is not known how it is derived. It is not the

average of (a), (b), and (c)

(23) Abraham and Sacerdote ("Recueil de Constantes Physiques," Table 166) give 299,890 as having been obtained by Michelson in 1902. No determination appears to have been made by Michelson at about that time, but, in that year 1902 he published a paper [xi, p 6, and xii, p 334] in which he adopted this particular value as the most probable estimate to date, being an average of the results obtained by Cornu ("discussed by Listing," vide infra), Newcomb, and himself. Is this the origin of the value given in the "Recueil"?

(24). A value 299,990, alleged to have been obtained by Listing from a rediscussion of Cornu's observations is mentioned by Newcomb [vi b, p. 202], by Michelson, quoting Newcomb [xi and xii, p. 333], and by Preston (loc. cit., p. 511) also quoting Newcomb. No trace of such a discussion by Listing could be found, but Helmert [1v, vol 87, 1876, p. 123] obtains precisely this value 299,990 by rediscussing Cornu's results. This value, obtained by Helmert, is quoted correctly by Michelson [vi a, p. 144], by Todd [v, p. 61] and by Cornu [ii, p. 227]; it only masquerades as Listing's in Newcomb's Report and in later works quoting or copying Newcomb. Occasionally, however, Michelson refers to this value as Listing's even when referring to another work in which it is attributed to Helmert [xii, p. 334, 1. 33]! As shown above, Newcomb made several errors of transcription, or misquoted from memory, and these were copied indiscriminately by Michelson and Preston. The, evidence is fairly strong in favour of Newcomb attributing wrongly the value to Listing (who had just published a paper [iv, vol 93, 1878, p. 369] on the solar parallax ("Finige Bomerkungen die Parallaxe der Sonne betreffend"), and that Listing's discussion of Cornu's results is non-existent. Later [x and xiii], Michelson gives Cornu's result as 299,950. This is neither Cornu's, nor Helmert's, nor "Listing's," as hitherto quoted by him and others after Newcomb; what it is could not be ascertained. It would be highly desirable that the confusion already existing should be prevented from spreading by the exertion of a little care in giving the origin of any information which cannot be traced directly to its authentic source.

The following abbreviations have been used for references which occur more than once :

1 Comptes rendus des séances de l'Académie des Sciences, l'aris.
11. "Rapports présentés au Congrès International de l'hysique,"
1900, vol. 2
111. Annales de l'Observatoure de Paris, vol. 13, 1876.
112. Astronomische Nachrichten
12. Astronomische Nachrichten
13. Astronomical Papers for the American Ephemeris and Nautical
14. Astronomical Papers for the American Ephemeris and Nautical
15. Astronomical Papers for the American Ephemeris and Nautical
15. Astronomical Papers for the American Ephemeris and Nautical
16. Almanac, vol 2. Part 3

Almanac, vol 2, Part 3
vi c. Astronomical Papers for the American Ephemeris and Nautical

VIC. Astronomical Papers for the American Ephemeris and Nautical Limanae, vol 2, Part 4
VII. Philosophical Transactions, 1882, vol. 173, Part 1.
VIII. Annules de l'Observatoire de Nice, vol. 11, 1908.
IX.a. Astrophysical Journal, vol. 60, 1924.
IX.b. Astrophysical Journal, vol. 65, 1927.
X. Journal of the Franklin Institute, November 1924, p. 627.
XII. Decennul Publications of the University of Chicago, vol. 9, 1902.
XII. Philosophical Magazine, 6th Scries, vol. 3, 1902.
XIII. NATURE, Dec. 6, 1924, p. 831

# The Tenth International Congress of Zoology.

F, as many contend, the chief value of these international gatherings is that they bring into personal touch the scattered workers in a single field or the larger number of workers in diverse but allied fields, then the tenth Congress of Zoologists, held in Budapest on Sept. 3–10 must be pronounced a distinct success. In spite of the clash with the Congress of Geneticists at Berlin, the British Association, and the meeting of Swiss Naturalists, there were registered no fewer than 862 members, though not all actually attended; those who did came from every civilised country north of the equator, and included delegates from 183 universities, academies, museums, and learned societies. The Governments of 24 of those countries were represented by 48 official delegates, those of Great Britain and China being apparently alone in declining the invitation. So far as the British Empire was concerned, the situation was saved by the appointment of Lieut.-Col. R. B. Seymour Sewell, I M.S., to represent the Government of India. Considering that the Congress was opened in the presence of the Minister of Education, Count Kuno Klebelsberg, and the Ministers or other official representatives of the leading Powers, and considering that on subsequent occasions selected delegates were received and entertained by the Regent and by Count Klebelsberg, it did seem to the British zoologists present that they might have been placed by their Government on a level with their distinguished colleagues from Turkey and Czechoslovakia.

This attitude of the British Government made it seem a shade ironical that the President, Prof. Géza Horváth, should have chosen the English language for just that section of his opening address which set forth the aims and results of applied zoology, the fight against the insect and mainmalian enemies of our forestry and agriculture, and the relations of zoology to medicine. Speaking in French, the president sketched the work of the Permanent Committee since the Monaco Congress in 1913, and deplored the death of two of its members, Edmond Perrier and Raphael Blanchard. In German he alluded to the results of experimental genetics and cytology and the help that modern zoology received from chemistry and physics. Finally, in Italian, he dwelt on the difficulty that specialisation placed in the way of a harmonious synthesis, and emphasised the service rendered by such a congress in knitting up the several lines of

This specialisation, coupled with the great diversity of the 260 communications presented at the general meetings and to the nine sections, makes it difficult to give a general survey of the scientific proceedings. One may set aside the laborious week spent by the Commission on Nomenclature and the animated but futile discussion in the section on that subject, for the main decisions will shortly be communicated to NATURE. One may also, for the immediate purpose, eliminate the section of experimental cytology, which came in rather as an annex to the Congress with the declared and afterwards fulfilled intention of budding off as an independent Congress. The zoology that was left appeared as a very different kind of science from the morphological and systematic zoology of the earlier meetings. The animal and all its parts down to the individual cell are now viewed less in their structural than in their functional aspect. A chord based on this note was struck by the four speakers independently selected by the organising committee to address the opening session.

Prof. R. Hesse, of Berlin, spoke on "The Ecology

of Animals: its Aims and Methods," defining

ecology as that branch of biology which considers life in relation to its environment. It provides an analysis of the struggle for existence, and its goal is the recognition of the 'Epharmonie,' that is to say, those characters which bring the creature into unison with its environment. A causal explanation would not, said Dr. Hesse, be attained without a more exact knowledge of animal chemistry. Dr. Bather, of the British Museum, speaking as a palæontologist, put to the systematist the question: Quo vadis? In the attempt to adapt a classificatory system, constructed with a different object and on a dissimilar basis, to a representation of phylogeny, systematists had got into a tangle. Greater recognition of similarities due to environment and their expression as classificatory 'grades' might save the situation. The adaptive dynamic characters of an organism were at least as important as the inherited, static characters. Dr. Charles Gravier, of the Paris Museum of Natural History, provided a concrete example of such a study. ın his account of "La phase pélagique de la vie des annélides polychètes à l'époque de la maturité sexuelle," and described the pairing-dance of the Palolo worm, as observed in the sea by means of a specially constructed lamp. Finally, Prof. R. G. Harrison, of Yale University, spoke on the status and significance of tissue culture. While the isolated cell dies and therefore cannot be observed, a cell-complex cut from the organism could be kept alive for an indefinite period. Carrel, for example, had kept the heart of a chick embryo alive since 1912. The study of living tissue would lead to a knowledge of the finer structure of protoplasm and of its regeneration. Thus the growth of nerve-fibres predicted on theoretical grounds by Ramon y Cajal could be clearly seen in a tissue-culture. The practical importance of tissue-culture lay in the help it could give to the fight against cancer.

To follow this theme—the organism as a living entity, working in harmony with its environmentthrough all the variations and illustrations submitted to the sections is impossible here. One can but point to a few of the papers read at the general meetings. In the first of these Prof. H. Spemann, of Freiburg 1. B., summarised the novel and important researches of his laboratory on what he terms "organisers" of animal development, a subject on which we hope soon to hear him in London. At the second session Dr. James Ritchie, of the Royal Scottish Museum, lectured on "The Influence of Man on the Develop-ment of Faunas." One of the effects on which he laid stress was the gradual killing off of the larger animals, with the result that the fauna of the world was assuming a more uniform character. At the same session Prof. A. Wandel, of Toulouse, directed attention to what he termed "Geographical Parthenogenesis," that is, the existence of species normally with sexual reproduction which in certain regions are strictly parthenogenetic, e.g. North European races of certain crustaceans, flies, butterflies, and other insects.

The third meeting listened to a most interesting lecture by Prof. K. v. Frisch, of Munich, on the senses and 'speech' of bees; to some new observations by Dr. G Brandes, of the Dresden Zoological Garden, on the life of the orang-utan, to an account by L. R. Natvig, of Oslo, of the breeding of Reindeer in Norway, where they number 135,000, and of the methods of fighting their parasites; to the description by Prof. P. Buchner, of Greifswald, of the symbiosis obtaining between certain wood-eating insects and fungi and infusoria; and to an account of some new experiments by Prof. Gilbert Rahm, of Fribourg,

which showed that life-processes could be entirely suspended in certain organisms without danger to life At the fourth session a large audience gathered to hear Prof. Voronoff, of Paris, and his pupil, Dr. Nemes Nagy, of Budapest, but had first to listen to Prof. Novikoff, of Prag, on the value of a study of analogy, and to Dr J Ettl, of Budapest, on the practical results obtained with human subjects by the regeneration and transplantation of tissue, the most remarkable being those cases in which bone was transplanted But the most applauded lecture of the Congress was that by Dr. Canti, of St. Bartholo-mew's, which had to be given three times. Dr. Canti's highly instructive films showing the growth of tissue and the actual division and mitosis of cells, have been shown more than once in London, but on this occasion he added films in which the results of irradiation by radium on the living tissue were clearly demonstrated. Dr. Canti had the honour of showing his film to Count Stefan Bethlen and Count Géza Telekı.

During the Congress members had the opportunity of visiting various museums and institutes, such as the National Museum, the Ornithological and Geological Institutes, the Zoological Garden, and the magnificent museum for agriculture, forestry, and land development, admirably adapted to the Hungary of pie-War days with its mines, its quarries, and its forests, but a melancholy reminder to the Hungary of to-day. The present wealth of Hungary lies in the heids and flocks of the great plain, which members had an opportunity of seeing on an excursion to the Hortsbagy Puszta, and in the vigour of its people all inspired with an intense desire to maintain the highest level of civilisation, as exemplified in the clinics of Debrecen University and the Biological Institute on Lake Balaton.

Small space is left in which to record the kindness and hospitality shown to foreign members by the Government, the Municipality of Budapest, directors of the various institutes, and indeed all with whom the visitors were brought into contact. pleased all to hear at the concluding meeting that the president, Prof. Horváth, had just received the Hungarian Cross for Distinguished Service of the Second Class.

The next meeting of the Congress is to be in Padua in 1930, under the presidency of Prof. Paolo Enriques. Prof. L Joubin (Paris) has been elected president of the Permanent Committee, with Dr. M Caullery as Secretary.

# University and Educational Intelligence.

BIRMINGHAM.—A legacy of £2000, bequeathed by the late Mr Christopher Collins, is to be added to the

Biological Building fund.

On his retirement from the chair of physiology, Prof E. W. Carlier has presented 120 volumes to the library of the Physiology Department. Prof. Carlier has also given to the department a most valuable set of 3000 microscopic preparations from his private collection, together with a number of teaching diagrams.

The Huxley Lecture is to be delivered on Thursday, Dec. 1, by Prof. A. S. Eddington, Plumian professor of astronomy and experimental philosophy in the University of Cambridge.

Among changes of the lecturing staff are the followmg: Resignations—Mr. H P. Dean (mechanical engineering), Mr. L. Eastham (zoology), Mr. J. P. Rees (mining), Mr. O C. Elvins (oil engineering). Appointments: Mr. D. A. M. Sandifer (mechanical engineering). gmeering), Mr. D. L. Gunn (zoology), Dr. W. Hancock (mine rescue work), Mr. R. Glossop (metal mining).

Cambridge —For the seventh year in succession. Truity College announces the offer of a Research Studentship open to graduates of other universities who propose to go to Cambridge in October next as candidates for the degree of Ph D.—The value of the Studentship may be as much as £300 a year if the pecuniary circumstances of the successful candidate require so large a sum. Applications must reach the Semor Tutor not later than July 1, 1928 — The same College offers, as usual, Dominion and Colonial Exhibitions to students of Dominion and Colonial Universities who wish to go to Cambridge next October as candidates for the degree of B A., M Litt. M.Sc, or Ph D The Exhibitions are of the titular value of £40, but their actual value is such sum (if any) not exceeding the titular value as the College Council may from time to time hold to be justified by the Exhibitioner's financial circumstances. If it is made clear that the financial need of an Exhibitioner cannot possibly be met by the payment to him of the full amount of his titular emolument the Council has power, it it sees fit and if funds are available, to award him an additional payment—Candidates must apply through the principal authority of their university, and applications should reach the Senior Tutor (from whom further particulars may be obtained) by July 1,

Edinburgh.--Dr C. H. O'Donoghue, professor of zoology in the University of Manitoba, Winnipeg, has been appointed to a senior lectureship in zoology, and Miss Irene A. F. Hilton, to a junior lectureship in zoology.

MANCHESTER.- Dr R. B. Wild, who has recently retired from the Leech chair of materia medica and therapeuties, has made a gift of £250 for the endow-

ment of a prize in pharmacology.

The following appointments have been made Assistant lecturer in metallurgy, Mr. W Cartwright, Assistant lecturer in geology, Dr. M. B. Hodge; assist-Assistant fecturer in geology, 12. ... C. A. Methaughey; ant lecturer in bacteriology, Mr. C. A. Methaughey; demonstrator in bacteriolgy, Mr. E. St. G. Gilmore, demonstrator in pathology, Mr. H. L. Sheehan; demonstrator in chemical technology, Mr. C. Chew

Sheffield - The University Council has made the following appointments: R. Cooper, assistant lecturer in mathematics; Dr. F. C. Chalklin, assistant lecturer in physics; and Miss Flora M. V. Brown, part-time assistant lecturer in botany.

THE Committee of the Leplay House Educational Tours Association has arranged a visit to Sicily during the coming Christmas vacation to study the history of the Island, mamly through its architecture, under the leadership of Mr. Stanley Ramsey. A regional survey meeting will be held at the Collège des Ecossais, Montpellier, at the invitation of Prof P. Geddes; the studies will be under the direction of Mr. George Morris. Full particulars can be obtained from Miss Margaret Tatton, Leplay House, 65 Belgrave Road, Westminster, S.W.1.

Mr. H. G. Beard, research assistant in the Department of Colour Chemistry at the Technical College, Huddersfield, has been appointed research chemist at Woolwich Arsenal. Mr Beard has received the whole of his chemical education at the Huddersfield Technical College, and for the past four years has been working under the supervision of Dr. H. H. Hodgson, head of the Department, with whom he has been the joint author of numerous papers published by the Chemical Society and the Society of Chemical Industry.

# Calendar of Discovery and Invention.

October 23, 1820.—The general substitution of wrought-iron rails for cast-iron rails in the early railways was brought about by the invention of John Birkinshaw, manager of the Bedlington Iron Works. Rectangular bars were first used, but on Oct 23, 1820, he patented the T form of rail, whereby increased bearing and strength were obtained with the same weight of material. He afterwards devised the fish-bellied rail which was used in the Stockton and Darlington Railway

October 24, 1851.—Lassell, whose discovery of Neptune's single satellite on Oct 10, 1846, has already been referred to, prosecuted his search for other satellites for many years, but without success until Oct. 24, 1851, when he discovered the third and fourth satellites of Uranus, and they were named

Ariel and Umbriel.

October 25, 1795.—At the height of the revolutionary period in France the various academies in Paris were suppressed, and for two years men of learning had no recognised status or meeting-ground. From the rums of the academies, however, sprang the Institut National, inaugurated on Oct. 25, 1795 (3 Brumaire, an iv.). The Institut to-day comprises five academies, of which the Academy of Sciences is one. At first it had various homes, but Napoleon housed it in the Collège Mazarin, built in 1663–70, as the Collège des Quatre Nations Réunies. Its anniversary meeting during the restoration was held on April 24, and under Napoleon III. on Aug. 19, but since 1870 it has always been held on the original day, Oct 25. One of the functions of the Institut is that of "registering discoveries and perfecting arts and sciences."

October 25, 1847.—At a time when photography, though in its infancy, was attracting considerable attention, Niepce de Saint-Victor, an officer in the French Army, following up the discoveries of his uncle, Nicephore Niepce and Daguerre, discovered a method of photographing on glass. He gave the first account of his process in a paper communicated to the Paris Academy of Sciences on Oct. 25, 1847.

October 26, 1711.—The Board of Visitors which

October 26, 1711.—The Board of Visitors which visits the Royal Observatory at Greenwich annually was first appointed by Queen Anne in December 1710, its origin being traceable to the unfortunate misunderstandings that prevailed between Flamsteed and some of his contemporaries. Apparently the first time the Board met the Astronomer Royal was in the rooms of the Royal Society in Crane Court on Oct. 26, 1711. The Board was empowered to demand from the Astronomer Royal a copy of his annual observations and to inspect his instruments. Flamsteed, however, had constructed some of the instruments at his own cost, and it is stated that when on this occasion he was requested to report on his instruments, he declared they were his own and he would suffer no one to concern himself with them.

October 27, 1806.—Napoleon, who had a keen appreciation of the value of scientific discoveries and inventions, often conferred rewards for such work. One instance was his recognition of the invention of the loom for figured weaving by Jacquard, to whom, by a decree dated from Berlin, Oct. 27, 1806, he gave

a pension of 6000 francs.

October 29, 1852.—One method of making electrotypes was that patented by Paul Pretsch, Oct. 29, 1852, under the name of photo-galvanography. From a transparency a gelatin relief image was obtained, which, being made conductive, was coated with copper. The copper shell was then backed with type metal to produce a printing plate.

E. C. S.

# Societies and Academies.

#### LONDON.

Society of Public Analysts, Oct. 5 -A Chaston Chapman. The oil of Centrophorus granulosus liver oil of the Portuguese shark 'barroso' (Centrophorus granulosus) contains the unsaturated hydrocarbon, spinacene, an alcohol probably identical with the batyl alcohol found in Japanese shark oils, a liquid alcohol (selachyl alcohol,  $C_{21}H_{10}O_3$ ), cholesterol and glycerol (0 5-0.6 per cent ), together with stearic, palmitic, and oleic acid, and possibly smaller proportions of other saturated and unsaturated fatty acids —W. R Schoeller and E. C. Deering: The separation of titanium from tantalum and niobium. The method is based on the dissociation of the soluble tartaric complexes of the metallic acids by a mineral acid, the earth acids are precipitated, whilst the titanic salt remains in solution The results as yet obtained are approximate—C L. Hinton and T. Macara. The determination of aldose sugars by means of chloramine-T, with special reference to the analysis of milk products Each molecule of chloramine-T is equivalent to two atoms of iodine, both in the oxidation of sugar and in the final liberation of rodine on acidifying. The oxidation proceeds more slowly than that with alkaline iodide solution The most suitable conditions for the oxidation of dextrose and lactose have been worked out, and the extent of the slight oxidation of sucrose and lævulose under standard conditions has been determined Under the conditions specified, the action of chloramine-T on the non-sugar constituents of milk serum does not cause an error greater than 0.4 per cent. of the total lactose.

### PARIS.

Academy of Sciences, Sept. 12.—Jean Perrin. Valency and addition compounds. A summary of various views of electronic valency with some applications to organic compounds.—Mme. Ramart-Lucas The mechanism of molecular transpositions. An application of the conception of inonoelectronic linkage, or semivalence, to the phenomena of intra-Pierre Viennot: molecular transpositions. geology of the neighbourhood of Hasparren (Basses-Pyrénées).—G Ollivier: Culleria monoica, gameto-phyte of Aglaozonia chilosa —A. Lebediantzef. The reaction to desiccation of different types of soils in the tchernozem and podzol zones of European Russia. -R. Wilbert: An infectious disease of the chimpanzee, transmissible to man. This disease, which appears to be due to a spirochate, caused the death of 32 chimpanzees out of 33. The author caught the disease but recovered. His blood contained the same spirochæte as the affected chimpanzees, and its inoculation into a chimpanzee caused its death.

Sept. 20.—A. Lacroix: The chemico-mineralogical characters of the tertiary intrusive and volcanic rocks of North Africa.—G. Bigourdan: The third general assembly of the International Geodetic and Geophysical Union. An account of the meeting held at Prague on Sept. 3–10, 1927.—T J. de Seze: The degree of accuracy of common formula of resistance of materials.—Mme. Christine Ladd-Franklin: The visible radiation arising from stimulated nerve fibres.—René van Aubel: The presence of crystallised uraninite in the uraniferous deposits of Kasolo (Katanga).

# Diary of Societies.

SATURDAY, OCTOIFE 22

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire District Meeting) (at the Mansion House, Doncaster), at 11 A vi

#### MONDAY, OCTOBER 24.

MONDAY, October 24.

Cambridge Philosophical Socials (Annual General Meeting) (in Caven dish Laboratory), at 130—G C Steward On the Lens Interferometer—J A Gaunt and W H McCrea The Emission of Radiation by a Quantipole Electric Moment on the Quantum Mechanics—E T. S Appleyand and Di H W B Skinner A Case of Double Reflexion—Dr F H Constable On Reichinstein's Displacement Principle—N F Mott The Gas Distribution Law in a Field of Force—G H Aston The Amount of Energy Emitted in the yray form of Radium E—To be communicated by title only—D Burnett The Relation between Refractive Index and Density—Dr R A Fisher and J Wishart On the Distribution of the Brition of an Interpolated Value, and on the Construction of Tables—Dr E Madgwick (a) The Absorption and Reduction in Velocity of β 13/8 on their Passage through Matter, (b) The β ray Spectrum of RaE—W H McCrea (a) The Specific Heat of Water Vapour and the Theory of the Dissociation of Water Vapour at High Temperatures, (b) The Specific Heat of Cubon Diovide and the Form of the CO, Molecule—R J Clark (c) A Convenient Method of Distillation of the Alkali Metals, (b) A Rapid Mercury Still

Beinburger in Royal Society, at 4:30—Presentation of Makdougal Brisbane Prize (1924-1925) to Dr C M Wenyon, and his address on Insect Flagellates and Disease A Study in Adaptation

Institution of Electrical Engineers (Informal Meeting), at 7—The President and others Discussion on What is required to Ensure the Comprehensive Distribution of Electricity?

Institution of Electrical Engineers (Informal Meeting), at 7—The President and others Discussion on What is required to Ensure the Comprehensive Distribution of Electricity?

Institution of Electrical Engineers (Informal Meeting), at 7—The President and others Discussion on What is required to Ensure the Comprehensive Distribution of Electricity?

Institution of Electrical Engineers (North-Eastern Centre) (at Armstrong College, Newcastle upon-Tyne), at 7—H Paterson Chairman's Address.

man's Address man's Address
Institution of Automobili Engineers (Glasgow Centre) (at Royal Technical College, Glasgow), at 7.30—Major E G. Beammont The Influence of the Automobile User upon the Automobile Engineer (Presidential Address).

ROYAL Society of Medicine (Odontology Section), at 8—W. Rushton Presidential Address — F N Doubleday: Chronic Fuso spirillary Infection of the Periodontal Membrane and its Treatment.

Medical Society of London—Di B B. V. Lyon and others Discussion on The Development of the Duodenal Tube and its Practical Value in Diagnosis and Treatment

### TUESDAY, OCTOBER 25.

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5 -Dr. V. Lyon: The Technique and Usefulness of Medical Bihary Diamage in Gall

The Technique and Usefainess of Medical Biliary Diamage in Gall Tract Disease
INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (Informal Meeting) (at Guildhall, Berby), at 6.45.—A E McColl. The Lanarkshie Hydro-Electric Scheme
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7—O. Bloch.
Clymburg Hebbary and Red Britainship the Distriction

Climbung Holidays and Bad Photography in the Dauphine.

### WEDNESDAY, OCTOBER 26

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. F. T. G Hobday: Diseases conveyed to Man by Animals
ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5.—
Prof. O. Charnock Bradley: What is Comparative Medicine '
INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers' Club, Manchester), at 7.—Major E G Beaumont The Influence of the Automobile User upon the Automobile Engineer (Presidential Address).
BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Medical Society of London, 11 Chandos Street, W.1), at 8 30.—Dr E Miller A Case of Claustrophobias.

of Claustrophobia.

### THURSDAY, OCTOBER 27.

CORE OVEN MANAGERS ASSOCIATION (Annual General Meeting) (at Hote<sup>1</sup> Great Central), at 2 30.—G. A Hebden: Presidential Address. FOLK-LORE SOCIETY (Jointly with Oxford University Anthropological Society) (in Geological Lecture Room, University Museum, Oxford), at 5.15.—Prof. J L. Myres: The Historical Content of Greek Folk-

memory.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.

CHILD-STUDY SOCIETY (at Royal Santary Institute), at 6.

SOCIETY OF CHEMICAL INDUSTRY AND INSTITUTE OF CHEMISTRY (Edinburgh and East of Sociland Sections) (at North British Station Hotel, Edinburgh, at 7.30—J. Adam Watson. Chemistry, the Slave of the Lamp (Inaugural Address)

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—F Kidd-Purpura of the Urinary Tract (Presidential Address).

MEDICO-LEGAL SOCIETY (at 11 Chandos Street, W 1), at 8.30—Sir William Willcoy Presidential Address.

INSTITUTE OF BREWING (Midland Counties Section) (at White Horse Hotel, Birmingham).—H. Lloyd Hind: Brewer's Microscope—a Demonstration of its Selection and Use, with some Hints on Photomicrography.

micrography.

Institution of the Rubber Industry (Manchester and District Section) (at Geographical Hall, Texile Institute, St Mary's Parsonage, Manchester).—W. A. M. Keith. Transmission and Conveyor Belting.

FRIDAY, October 28

ASSOCIATION OF ECONOMIC DIOLOGISTS (at Imperial College (Botany Department), South Kensington), at 2.30—Agriculture in Tropical Africa—Dr. E. J. Butler. Planting Developments and Difficulties in Nyasaland—W Nowell. The Work of the Amani Institute. ROYAL SANTARY ISSTITUTE (in Town Hall, New astle upon-Tyne), at 4.30—Discussions on The Influence of Overcrowding upon Tuberculosis, with special reference to the New Housing Schemes, The New Factories Bill, and The Smoke Problem on Tyneside—How is it to be Tackled?

Physical Society (at Imperial College of Science), at 5.

be Tackhed?

Physical Society (at Imperial College of Science), at 5

Royal College of Strodons of England, at 5—Sit Arthur Keith.

Demonstration on Congental Dislocation of the Hip and other Joints

Society of Chemical Industry (Liverpool Section) (at University,

Inverpool), at 6—Dr. A. Holt Merseyside and Chemical Industries

Institution of Chemical Engineers, (at Institution of Chal Engineers),

at 6:30—Sit William Brack Crystallisation (Lecture)

Institution of Locamonium Engineers (Manchester Centre) (at College

of Technology, Manchester), at 7—E. C. Poultney Locamotium Per
tormance and its Influence on Modern Practice.

Institution of Michanical Engineers (Informal Meeting), at 7—

L. Pendred and others. Discussion on Engineering in the United

States of America.

L. Pendred and others Discussion on Engineering in the United States of America Manchester Literary and Philosophical Society (Chemical Section),

WEST COMBURGAND SOCIETY OF CREMISES AND ENGINEERS (at Technical College, Workington), at 7—J E Lambert Use of Explosives in Mining and Quarrying
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7-30—Technical Film Illustrating the Production of Cotton Goods
ROLAL Society of Medicine (Epidemiology Section), at 8.—Dr.-M. W Goodall The Epidemic Constitution
PHILOLOGICAL SOCIETY (at University College), at 8—Rev E D
Priestley Brans Place-names in Minister
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SRIPBULLDIPS
(Annual General Meeting) (at Newcastle upon-Tyne) - M. S Gibb
Presidential Address.

### PUBLIC LECTURES.

SATURDAY, OCTOBER 22.

HORNIMAN MUSEUM (Forest Hill), at 3 30 -Mis. II M. Dunn The Peoples of India. MONDAY, OCTOBER 21.

School of Oriental Studies, at 5 15 -E R Wood Travel in East Africa

TUESDAY, OCTOBER 25.

GRESHAM COLLEGE, at 6—A. R. Hinks A New Survey of the Nebule. (Succeeding Lectures on October 26, 27, 28.)
UNIVERSITY COLLEGE, at 9.—Prof J Garstang: Research and Discovery in Palestine, with special reference to the Hebrew University.

### WEDNESDAY, OCTOBER 20

King's Colligr, at 5:30—A Rannie The Preparatory School. Institute of Historical Research (Malet Street, W.C.1), at 5:30—N B Jopson: The Early Civilisation of the Slavonic Peoples (Succeeding Lecture on November 2) Lordon School, or Economics, at 6—C Wilson Office Machinery, Underwood Invoicing and Book-keeping Machines.

### THURSDAY, OCTOBER 27.

UNIVERSITY COLLLOL, at 5-30.—Viscount Cecil of Chelwood. The Cooperation of Nations (Rickman Godlee Lecture).
ROYAL SANITARY INSTITUTE, at 5-30 — W Hales. Tropical Vegetation and some of its Uses to Man (Chadwick Public Lecture).

### FRIDAY, OCTOBER 28.

University College, at 5.15.—Prof B Němec Symbiosis Parasitism and Immunity in Plants

SATURDAY, OCTOBER 29.

HORNIMAN MUSEUM (Forest Hill), at 3.30 .- M. A Phillips: Nature at Home.

#### CONGRESSES, ETC.

#### SATURDAY, OCTOBER 22.

Union of Educational Institutions (Annual Meeting) (at Education Offices, Birmingham), at 3

OCTOBER 22 TO 24.

CONGRESS OF THE ITALIAN SOCIETY OF LARVINGOLOGY, RHINOLOGY, AND OTOLOGY (at Parma). OCTOBER 23 TO 26.

MARCELIN BERTHELOT CENTENARY CELEBRATIONS (at Paris)

OCTOBER 23 TO 26.

ITALIAN CONGRESS FOR COMBATING TUBERCLLOSIS (at Milan).

OCTOBER 24 TO 26

ITALIAN CONGRESS OF INDUSTRIAL MEDICINE (at Parma, Modena, and Carpı). OCTOBER 25 TO 28.

INTERNATIONAL CONGRESS OF HYGIENI (at Paris).

OCTOBER 29 AND 30.

ROUMANIAN CONGRESS OF OTO-RHINO-LARYNGOLOGY (at Bucarest).



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# Natural Science in Adult Education.

THE growth of knowledge, and the necessary limitation arising from the age and duration of school life, create an ever-widening gap between the actualities and possibilities of education. The boy or girl who leaves school to enter some profession is usually able to secure suitable further training in part-time classes at a local technical school or college But there are many men and women who have no need of special training, or have already obtained what they require, but have intellectual needs which call for satisfaction. They read newspapers and books; they are members of clubs or societies; they acquire an interest in social or political or economic problems, or in philosophy, or literature, or science, and they enter into eager controversy on the problems of the day. Those who possess depth of feeling or understanding, whose interests are not the languid ephemeral interests of the man in the street, realise the need for wider and deeper knowledge, for training in methods of study, for direction of reading, and for friendly guidance and criticism.

Training of this kind has been provided for many years in University Extension Courses, in the last quarter of a century in classes under the Workers' Educational Association, and more recently in the London Literary Institutes. The work has become an integral part of national education. It is aided by Local Education Authorities, and has acquired sufficient magnitude and importance for Treasury grants to be administered under a separate set of regulations—the Adult Education Regulations of the Board of Education.

The training in these classes exists in response to a distinct demand. This demand is usually for something which bears upon the wider aspects of intellectual life rather than upon the narrower requirements of an occupation It represents a desire for knowledge for its own sake, a desire to share in the intellectual heritage and to understand some aspect of the material or intellectual progress of the generation in which they live. It arises at a later age than that at which students pass into technical schools or universities for professional or occupational study; and however complete may be the facilities for the continuous full-time education of all who appear when young to be capable of profiting by it, the need for this kind of training will remain.

From this point of view the field of adult education is not limited to economics, to history, or to literature, but extends over the whole field of

human knowledge; and we welcome the interesting and instructive report 1 of the Adult Education Committee recently issued by the Board of When the Committee commenced its Education labours in 1921, most of the classes were in economics and history. At the first meeting, Mr Fisher, then president of the Board, expressed the hope that the Committee would "investigate the possibility of extending the range of studies in the adult education movement" As a result of its observations the Committee is able to note in 1927 "a distinct tendency in this direction" particular, "classes in English Literature have increased greatly both in numbers and in proportion to the whole," and "the growth of interest in Music and the Drama has also been considerable " But the Committee deplores the fact that "there has been no corresponding growth in the number of classes in Natural Science"

After reviewing the value of natural science as a humane study, in everyday life, and in industry, the report discusses the evidence of an interest in the subjects which fall under the vague yet comprehensive title. There appears to be some doubt whether the interest is now so great as it was fifty years or more ago; but the conditions of life are so different that no comparison is of much value. much greater proportion of young people obtain instruction in the elements of natural science at school; a greater number of students attend technical schools in which the instruction is far more specific and highly organised, far less academic or of general interest, than it was even twenty-five years ago; local travelling facilities have immensely improved, and the means of employing lessure are more varied than they used to be; Local Education Authorities are more independent of external aid, and inclined, on the ground of expense, to concentrate on what appears to be the primary function of the local technical school. The pioneer work of the famous men who upheld the banner of science in the last century can scarcely be compared with that expected in a tutorial class conducted by the Workers' Educational Association to-day. The circumstances have altered and the aims are not the same.

In regard to the existing provision, we note that in 1925-6 "the number of courses in Natural Science recognised under the Adult Education Regulations was 47 out of a total of 1224; the number of students attending these courses was 935 out of a total of 26,806." These figures do

1 "Natural Science in Adult Education" Paper No 8 of Adult Education Committee (London: HM Stationery Office, 1927)

not include non-vocational courses promoted la Local Education Authorities. From such statistics as the Committee has been able to obtain it concludes that "the study of Natural Science being neglected in comparison with other studies."

The courses described or commented upon cover a wide field, but are conveniently grouped under biology, geology and geography, and the physical By reason of their human interest, sciences classes in biology have been especially successful and in some cases have been continued for four years or more. Very little apparatus is required, and the classwork is supplemented by field excursions and visits to museums. Geology and geography also call for little special accommodationor equipment. The requirements for physical science vary widely with the branch chosen, but even where laboratory work is not necessary there may be a need for a degree of mathematical knowledge not usually possessed by adult students.

Apart from differences of method, advocated by different witnesses, there appears to be a greater similarity of content, and more uniformity of aim, in courses in biology and geography than in physical science. The former almost invariably suggest a wide view of the universe and of the evolution of living things; the latter vary from "Chemistry of Everyday Life" or "Chemistry in the Home" to "Modern Views of Matter" and similar subjects.

There is an implication on page 20 of the report that biology is more widely studied in Tutorial Classes and the physical sciences in Extensior Classes; and on page 52 the mathematical and experimental requirements are referred to it support of the view that physical science is lessuited "to the method of a Tutorial Class." Busince the original condition of the Adult Educatio Regulations that "the instruction must aim at reaching, within the limit of the subject covered the standard of University work in Honours," now only applies if the subject is such as to make that a possible aim, the suitability of physical science for a Tutorial Class seems to depend mainly upon the syllabus and the teacher

The report recognises the need for competent teachers, and advocates the appointment by the universities of staff tutors for this work. It complains that the high degree of specialisation at the universities does not provide men with the requisite breadth of training. On this matter we are at one with the Committee. But something more than breadth of knowledge is required. The man who is to attract and retain adult student

requires personality. He must have sympathy and understanding, and be able to realise the content and attitude of mind of those who come to him for instruction and inspiration He must have such et grip of his subject that he can break down traditional and academic barriers between branches of knowledge-barriers which, while not inappropriate in a full-time university course, are unnecessary and frequently out of place in a course which will rarely permit of more than 150 hours' instruction, he must know not only how to learn himself, and how to present his subject attractively, but also how to train his student to learn for themselves. Also, if he wishes to enjoy, and help others to enjoy, the pleasure of learning, if he wants to feel, and make others feel with him, the exquisite thrills which accompany mental growth, he must have a command of language which will enable him to clothe the dry bones of fact and theory, and make them live.

While we share the desire of the Committee to see an increasing number of classes devoted to the study of natural science, we do not desire a rate of increase greater than that of the supply of competent teachers. For if the teaching is to be humane, if it is to reveal the patient and accurate observation involved in scientific investigation, if it is to train judgment, if it is to create awe and reverence for the wonders of the universe, it must be based upon qualities for which academic attainment is neither a measure nor a guarantee.

# X-Ray Analysis.

Die Verwendung der Röntgenstrahlen in Chemie und Technik: ein Hilfsbuch für Chemiker und Ingenieure. Von Dr Hermann Mark (Handbuch der angewandten physikalischen Chemie in Einzeldarstellungen, herausgegeben von Prof. Dr. Georg Bredig, Band 14.) Pp. xv + 528. (Leipzig: Johann Ambrosius Barth, 1926.) 48 gold marks

DESPITE the recent large output of books dealing with X-rays and their applications, this addition is a very welcome one. Himself a leader of the German school, Dr. Mark has brought to his task a quite exceptional knowledge of the theory and practice, and it would be difficult to find any one better fitted to produce a sound as well as a helpful text-book of this subject. Issued as a volume of a new handbook of applied physical chemistry, it is described by its author as a book intended for the guidance of chemists and engineers. It is more than this, it is a book to be possessed by all who have to deal with X-ray problems.

The main object is to introduce the reader to, and train him in the methods of, X-ray crystal analysis, and for such an end to be successful it is necessary to discuss the nature and properties of X-rays, the theory of the older crystallography, and then the applications of X-rays to the problem of the solid This is briefly the general scheme of the In the earlier chapters the methods of book production of X-rays are described in a very practical way. Details and working instructions of the essential apparatus are given, details sufficient to enable even the inexperienced to select a suitable equipment and to know in advance the difficulties he is likely to meet and how they may best be over-There follows an account of X-ray spectrometers and spectroscopy, and of the most important properties of the rays themselves, with very complete tables of wave-lengths and other useful data.

In the same masterly way, the subject of crystal-lography is introduced, and this section contains all the formulæ and information that are likely to be required. Before proceeding to discuss the actual procedure of X-ray analysis, Dr. Mark inserts a chapter on the essentials of the wave theory of diffraction, leading up to the crystal grating by a discussion of the simpler optical systems. He thus gives the necessary analysis to which he can refer when the question of intensity interpretation has to be discussed later.

The author is now in a position to deal with his main problem, the application of X-rays to the structure of the solid, and he proceeds to do so in a very thorough and systematic manner. So far as it is possible to lay down definite rules of procedure, he does it and reproduces for this purpose, in convenient form, tables differentiating the various space groups. These tables, although not quite free from errors, should reduce the time and labour of obtaining the space group of a crystal to a minimum. This determination of space group, or classification of the crystal as belonging to one of the 230 possible configurations, is now a routine business and should always be possible if suitable material is available. But the details of atomic arrangement are not, as a rule, determined when the space group has been found. The complete solution of the structure involves also a discussion of the intensities of the X-ray reflections. This is a much more difficult problem, but in the section devoted to this question the reader will find an excellent survey of the position as it stands to-day.

It is difficult to think of anything essential which has been omitted. Whether his material is in the

form of a single crystal, a random collection of small crystals, or in that very interesting state in which the crystallites are not oriented at random but have some direction in common, the worker will find here the necessary information to enable him to attack his problem No attempt has been made to gloss over the difficulties, but, in spite of this, the book is essentially a practical one Some of those to whom it is especially addressed may find it difficult in places, but they can rest assured that they are not likely to find a simpler yet equally comprehensive account elsewhere. The occasional excursions into mathematics need not deter them unduly. They will find that the working rules are often independent of this analysis and quite intelligible even if all the steps leading to their deduction have not been followed in detail.

Here, then, is a book especially for the practical worker, a book which he will keep on his desk and to which he will find himself continually referring. Every one whose interest lies in this field owes Dr. Mark a debt of gratitude for his labours in writing such a sound and such an eminently useful work, and there will be many among them who would appreciate the appearance of an English translation We have but one quarrel with it, in due course and that is its price. It is certainly a large volume, and the many excellent illustrations and tables must have increased the cost of production, but it seems a pity that a book which is invaluable to all concerned should be issued at a price which puts it almost beyond the modest purses of many to whom it would be most helpful.

## Primitive Peoples of Assam.

The Ao Nagas. By J. P. Mills. With a Foreword by Henry Balfour and Supplementary Notes and Bibliography by Dr. J. H. Hutton. (Published by direction of the Government of Assam.) Pp. xviii + 500 + 32 plates. (London: Macmillan and Co., Ltd., 1926.) 30s. net.

THE Government of Assam is evidently not content with that superficial knowledge of the decaying culture of its subjects which is so frequent a failing of governments which have to deal with primitives; for the present volume, published under Government auspices, is an addition to an important series of monographs on the more primitive peoples of Assam and maintains the high standard of the earlier volumes. Mr. Mills gives us the results of an intensive study of one important group (comprising a population of some 30,000) of the peoples of the Naga Hills.

Material culture, social organisation, and religion are exhaustively dealt with, and a short grammar of the language is given.

It is interesting to find that the clans in most of the Ao territory are grouped into three exogamous phratries, an unusual form of organisation, while in one part there is a 'dual organisation' such as we find in parts of Melanesia. It has not escaped Mr Mills's notice that Melanesian affinities are very numerous, and his book affords further proof of the close cultural connexion between the two areas A feature of the social organisation, worthy of special remark, is the grouping into three-year agegrades, a grouping not brought about by mitiation but directly dependent on the year in which a person is born. Grades within the 'men's house' result from this arrangement, and even the elected councillors of the village form a wider age-grade of a generation, the older generation of councillors being eventually replaced en bloc by the next generation below.

The Ao believes that he has a number of souls, one of which is, perhaps, better regarded as 'soulsubstance,' though Mr. Mills does not use this term. Head-hunting, a most important institution of the Nagas, is closely connected with these beliefs, for the souls of dead men are wanted to fertilise all vegetable and animal life and to add to the general stock of vital essence in the village, and the soul is located in the head above all other Sacrifices to stones and spirits are most important, and there is a complex series of feasts with sacrifices by means of which a man acquires merit. Some interesting notes on the effects of mission work are given in an appendix, and Mr. Mills ! reaches the conclusion, favoured by most anthropologists, that, although the mission may confer ; considerable good on the native, much harm is also done by the destruction of tribal life beyond the point of political necessity.

The usefulness of the book is augmented by a chronological bibliography of the Naga Hills by Mr. Hutton, who has also added valuable notes to the text. The book is well illustrated and provided with a map. There is an excellent index.

Mr. Mills is to be congratulated on his valuable contribution to ethnology, for, as Mr. Balfour remarks in the foreword to the work, "detailed ethnographical monographs, such as the present work, compiled without the bias of any fixed and inelastic theory, afford to the comparative ethnologist reliable material upon which he can work," and, it may be added, such monographs are comparatively rare.

W. E. Armstrong.

## Science and Survival.

The Bridge: a Case for Survival. Compiled by Nea Walker With a Prologue and an Epilogue by Sir Oliver Lodge Pp xi+314+16 plates. (London, Toronto, Melbourne and Sydney Cassell and Co, Ltd., 1927.) 21s. net.

SERIOUS study of the phenomena of the 'mediumistic' trance can be divided into two main classes—the work hitherto done through mediums on supposed supernormal communications which are alleged to come from the dead; and the elucidation of those products of automatism usually styled the 'cross correspondences.' Of these, the flist class is of some considerable scientific interest, and the present volume is a further contribution to the subject along those lines

A devoted married couple, Mr and Mrs White. were separated by the death of the former, and the latter, seeking consolation, applied to Sir Oliver Lodge for assistance As is usual in such cases. the applicant was put in touch with Sir Oliver's secretary, Miss Nea Walker, the compiler of the present volume. With her help Mrs White visited certain mediums in Cardiff near her home, and with them she obtained information which. it is alleged, they could not have normally known This beginning was supplemented by sittings on behalf of Mrs White taken by Miss Walker with the medium Mrs Leonard, and also by private sittings with Miss Walker's sister, Damaris, who is supposed also to possess 'psychie' faculties Later, Mrs. White herself had sittings with Mrs. Leonard, and finally dying she 'came through' at sittings which Miss Nea Walker arranged with Mrs. Leonard. This is, in short, what is known as the White Case, and it is here presented as evidence for the survival of bodily death and the continued interest in, and knowledge of, earth conditions by those who have passed beyond the veil.

The evidence consists in the main of a mass of intimate and trivial information recognised as appropriate by Mrs. White, and in many cases given through mediums and to sitters unknown to her or to her deceased husband. Such trivialities do not weaken the evidence. In certain cases they strengthen it, especially when the material is of such a nature as not to lend itself easily to coincidence. Thus, at one sitting when Miss Walker was acting as deputy for Mrs. White, the 'communicator,' purporting to be Mr. White, remarks that he thinks that at the end of the previous week, about nine days ago, they were looking at a sunset together. As a matter of fact, exactly nine

days previously, Mrs White had noted down in her diary that she had been looking at a sunset and had been thinking of her life with her husband whilst doing so. There are a good many incidents of a similar character scattered up and down the records of the sittings, and interspersed among them are names of persons connected with Mrs. White which would not have been easy to obtain through normal means

Now it would be hazardous to advance the supposition that all the information given through the various mediums and here described was derived from normal sources revealed fraudulently. Certainly it would seem that at least some of it was derived from some hitherto unrecognised source which is usually described as 'supernormal' However that may be, it is a pity that some competent psychologist, alive to possible sources of error, did not supervise and systematise the experiments from the start Thus, we are told that Miss Walker originally sent Mrs White's letter asking for assistance to "a man in Cardiff" Is it not legitimate to ask who this man was, whether he knew of the mediums to whom Mrs White afterwards went, whether he showed the letter to any one, and if so, whether these persons knew the mediums concerned ? These and many more similar questions immediately arise, but no answer to them will be found in the pages of this book. Again, how unsatisfactory it is to have one of the principal mediums, Damaris Walker, living in the same house with the principal investigator Moreover, what an opportunity was missed when Mrs. White herself died. Instead of sending someone who was not aware of Mrs. White's death to take a sitting for Mr. White to 'communicate,' Miss Nea Walker herself goes, and, presupposing some telepathic rapport between herself and the medium, it is not surprising that Mr White affirms the presence of his wife, although strangely enough the control, Feda, does not seem aware of it.

To any one acquainted with the history of the evolution of the human mind and not already persuaded, "The Bridge" will scarcely carry conviction. It may stimulate independent investigation of the problems underlying the real meaning of the odd phenomena associated with the mediumistic trance. Systematic experiments, independently checked and verified at every stage, are, it is admitted, very difficult of execution, but certainly ought to be attempted. Thus, it ought not to be permitted, as was done in the present case, for the sitter to be present alone with the medium and take personal notes in long-

hand. It is admitted in the 'White Case' that a selection has been made, and it is obvious in what direction it operated. If telepathy occur at all, then the laws underlying it will only be discovered through the most rigid control conditions being applied.

At present we see little appreciation of this fact in the writings of psychical researchers. It remains to be seen whether, when sufficiently strict control conditions are applied, the 'phenomena' tend to disappear as seems to be the case with the so-called physical phenomena of spiritualism When normal knowledge, chance coincidence, common associations, deliberate fraud, and hyperæsthesia are eliminated, what remains ? Is there, in fact, any residue left for examination? Certainly in such 'phenomena' as are exhibited in the published 'cross correspondences' there would appear to be little, if any. In the communications given through mediums there would seem to be something for which no normal explanation is readily available, and this volume provides a good example of the latter category.

## Indian Malarial Research.

Malaria: its Investigation and Control; with special reference to Indian Conditions. By Major Robert Knowles and Ronald Senior-White Pp. vii + 220 + 6 plates. (Calcutta and Simla Thacker, Spink and Co., 1927.) 78 rupees.

HEN the professor of zoology in the Calcutta School of Tropical Medicine, and a worker in the Central Malaria Bureau of the Government of India with previous wide field experience in Ceylon and India, collaborate in a monograph on the investigation and control of malaria intended for men of the Indian assistant-surgeon class, its scientific and practical hygienic value are assured, when they dedicate it with respectful homage to the wives of research workers, in recognition of their sufferings in the cause of science, the illumination of humour helps perspective; and when they permit in the book the issue of advertisements of material pertinent to the subject, they perhaps but follow closely in the footsteps of the School's distinguished founder, for it was he who persuaded the merchants of Calcutta to contribute so liberally, and, so far as they were concerned, so unexpectedly, to its finances that they assured him that his missed vocation was that of company

The first two chapters of the book deal with the malaria parasites in man and anopheles and No. 3026, Vol. 120]

acknowledge fully the writer's indebtedness to Wenyon's "Protozoology," although Knowles is in error in attributing to that book and author the original intimation that if Plasmodium ovale Stephens be valid species its valid name is P. minutum Emin, 1914. That effect of the working of the Code of Zoological Nomenclature was indeed pointed out in the Tropical Diseases Bulletin three vears earlier. While on this subject, it may be noted that the specific names of the anopheles cited do not all appear to comply with the law of These chapters contain three valuable coloured plates of the various stages of development of the three species of Plasmodium parasiting the blood of man, and a fourth, particularly striking in its simplicity and clearness, of the relations of the human and anopheline cycles of the plasmodial life-history

There is one point on which Knowles lays some stress, the statement that gametocytes do not appear early in an infection, not perhaps for ten days or more, their appearance being due, it is suggested, to conditions becoming unsatisfactory for schizogonic multiplication. Warrington Yorke and Maefie, in their transmissions of P vivax by mosquitoes in the treatment of general paralysis, have, though rarely, found gametocytes in the circulating blood as soon as any forms have been discovered there, and, in all instances, two or three days later. It is reasonable to conclude that gametocytes come into existence as soon as do schizogonic forms, but in numbers too sparse to be detected in the circulating blood by our present diagnostic means.

The reasonableness of this explanation is strikingly illustrated by an incident cited in the book where some fifty thin smears from one man were distributed among the School class with the view of eliminating *P. falciparum* infection, for it was intended to use this blood, which was infected with *P. vivax*, in the treatment of general paralysis. Rings suspicious of subtertian malaria were found in three smears, and a crescent in a fourth—Should the sexual forms, essential for the survival of the species, appear only when conditions are unfavourable for schizogonic multiplication, the observation would have wide zoological implications, so that hesitation in accepting this position is justified.

With experience of the diagnostic uncertainty of thin films, such as has just been indicated, there is little wonder that Knowles is a convinced advocate of the thick film for the diagnosis of malaria, and full and careful directions are given for its preparation with a view of ensuring that plasmodia shall always be detected therein if they are present Culture is advocated for diagnosis if the thick film prove negative and doubt still remains, thus following Sinton, in whose hands it has in these conditions been successful, the amount of blood usable amount to 1 c.cm. A fifth coloured plate illustrates the normal and abnormal cells which may be found in a stained blood film.

Very convincingly, Knowles unfolds the argument against 'parthenogenesis' in Plasmodium, but, unfortunately, it is not, as he writes, "now as dead as mutton", it has recently been sponsored by a great French scientific society in considered advice to the French Government.

The line of treatment inclined to is Sinton's alkalme quinine mixture, but as regards total dosage sufficient stress seems scarcely to be laid on the difference in reaction to the cinchona alkaloids which is shown by a recent and by an 'established' infection, both conveyed by the mosquito. Perhaps for the book's purpose such stress is useless, in view of the unlikelihood of detecting a new early infection in those who have been infected in, and have relapsed or been reinfected since, The cinchona alkaloids other than childhood quinine, and the mixture known as cinchona febrifuge, are considered. The very strong reasons against giving quinine by the intra-muscular route are fairly marshalled, the invariably resulting necrosis is stressed, and some of the appalling consequences illustrated After all, seeing that the Indian sub-assistant surgeon does give intravenous injections of tartar emetic for kala-azar at the rate of about two a minute in Assam, there is little excuse by any one to avoid the sure and rapid intravenous route for quinine, where the oral route is contraindicated.

Senior-White describes the making of a malarial survey, and the design, construction, and maintenance of anti-malarial measures, and furnishes appendices. These comprise the breeding places and distribution of Indian anopheles, and a key for the identification of the imagines sponding key for the mature larvæ is accompanied by a sketch of the entire larva with its anatomical parts named; an idea which will, no doubt, be extended to the imago in another edition keys are usefully illustrated throughout. The last appendix consists of a copy of the specification which has been found so valuable for the construction of subsoil underdrains in the Federated Malay States A considerable bibliography follows. The book fills well the limited function for which it is CLAYTON LANE

#### Our Bookshelf.

Comets and the Sun · New Theories regarding their Structure By Dr John W. Weir Pp xvi+72 (London: Longmans, Green and Co, Ltd, 1927) 12s 6d net.

This book is very well illustrated, it contains reproductions of photographs and drawings of Halley's and other comets, made at the principal observatories, also photographs of sunspots and the corona, and a large coloured drawing of a solar prominence. A considerable part of the text is taken up with quotations from the writings of well-known astronomers, some of the passages quoted were, however, written before the recent advances in atomic physics, and are now somewhat out-of-date.

Cometary physics are very difficult to explain in a perfectly satisfactory manner, and it is unwise to be too dogmatic in condemning any suggestion as being certainly unsound, some of the author's suggestions are, however, rather difficult to accept Thus he suggests that the tails of comets are bounded by an envelope, which he appears to picture as a sort of membrane It must be admitted that the well-known drawing by Gen G. H Willis of the great comet of 1882 lends some support to the suggestion, yet it is difficult to reconcile it with our knowledge that the tail is not at rest with respect to the head, but is continually being driven outward by powerful forces. Again, the author invokes currents in the interplanetary medium to explain some features of the tail. The study of cometary movements clearly shows that the medium offers no sensible retardation to the motion of the comet as a whole; still less could its differential action between different parts of the comet be sensible. There are similar difficulties in some other suggestions, still we may admire the author's enthusiasm for his subject, and his desire to throw new light upon it, even if we are unable to A. C. D. C. accept all his ideas

A Text-Book of Geology By Philip Lake and R H. Rastall. Fourth edition. Pp xiv + 520 + 33 plates (London . Edward Arnold and Co., 1927) 21s net

THE fourth edition of the deservedly popular "Lake and Rastall" remains unaltered in plan, but a considerable number of minor changes and a few brief additions have been made. For the most part these are insufficient to indicate to the student the remarkable developments in geological interpretations that are at present in full swing. It may be that the authors feel that the time is not yet ripe for the incorporation of modern advances into the scheme of an elementary text Certainly it would be difficult to introduce the newer outlook into any already existing text-book Nevertheless, more attention might have been given to isostasy; the structure of the crust as revealed by earthquake records; the work of the Carnegie Institution of Washington on the nature of volcanic activity, and the far-reaching consequences of the recognition of radioactivity as a source of internal energy Only nine lines are devoted to the continental drift hypothesis, and vulcanicity in all its forms is still regarded as "merely a secondary effect of the greater class of phenomena dependent on the cooling and contraction of the globe as a whole"

At present there is generally a marked difference between geological text-books and courses of lectures, and the above comments are offered in the hope that in future editions of this and other books of similar scope (e.g. American) some serious attempt will be made to make the gap less obvious Meanwhile our "Lake and Rastall" remains by far the most generally useful text which is at present available for elementary students. We welcome its improvements and hope for more when the present edition is exhausted.

La construction collective de la maison en Kabylie: étude sur la coopération économique chez les Berbères du Djurjura. Par Prof. René Maunier (Université de Paris Travaux et Mémoires de l'Institut d'Ethnologie, Tome 3) Pp in +81 +3 planches (Paris Institut d'Ethnologie, 1927.) 45 francs.

In this study of the erection of a Kabyle house the author is primarily concerned with the sociological aspect, and the technological and religious aspects —for certain stages of erection involve a religious ritual with sacrifice—are dealt with only summarily and incidentally in so far as some account of them is necessary to comprehension of its building as a social activity. The character of the Kabyle house is determined to a large extent by the environment and by the economic activities of the people intensive character of the occupations of the people, as is usual in the circumstances, tends to the concentration of a completely self-supporting unit under each roof Each house is inhabited by a single family. It is, however, essentially the place of women's occupations; the men use it only for eating and sleeping, while unmarried sons of adult age sleep in a kind of club-house. But as a small group of this kind is not adequate to the labour of erecting a new house, the help of relatives and then of the whole community is called in. New houses are usually erected on the marriage of a son, and there is a tendency for each new house to be grouped around that of the parents, thus creating a community within a larger unit. M. Maunier's book is a valuable piece of work which well illustrates the function of and method of working of a communal activity.

The Story of Myths: for the Use of Students in Training Colleges, and Others. By E. E. Kellett. Pp. v+275. (London: Kegan Paul and Co, Ltd, 1927.) 7s. 6d net.

In the course of the lectures, or rather informal talks to training college students, which furnished the material from which this book has been made, the author disclaims any attempt at exhaustive treatment of the various classes of myth. He has, however, covered a sufficiently wide field, and within the limits he has imposed upon himself, his

treatment of the subject is scholarly and shows The chapters on psychological elements in the growth of myth and on existing relies of old custom and myth will be found especially valuable in giving the student the point of view of the student of folklore in approaching his material, and the conditions, both psychological and cultural, of the myth-making stage m the development of the human mind. The principal classes of myth which the author analyses are those relating to the heavenly bodies, sky and sea, creation, great catastrophes such as the flood, birth and death, and twins The chapter on the history of folklore might have been a little more systematic. Some notable names are not mentioned, for example, Sir Laurence Gomme and Sir John Rhys. A select bibliography would have been an advantage, and have added materially to the value of what is, within its limits, an excellent The index is particularly good and useful

Applied X-rays By Prof. George L. Clark. Pp xiii+255. (New York · McGraw-Hill Book Co., Inc; London McGraw-Hill Publishing Co., Ltd, 1927.) 20s net.

In this admirable volume, Prof. Clark gives what is probably the first extensive and scientific account of the progress made in the application of X-rays to the solution of the special problems of industry. Even to readers more or less in touch with X-ray work in general, the extent and variety of the subjects dealt with in the book will come as a surprise The application of X-rays to the solution of problems connected with the behaviour of metals and alloys under strains, with the composition of chemical compounds, with catalysts, colloids, textile fibres, varnishes, dyes, soaps, dielectries, adhesives, abrasives, cements, coal, and gems, are some of the many subjects with which the author deals. It is not surprising that he foresees a great future for this new and rapidly growing branch of applied science.

Prof. Clark writes not only with enthusiasm but also with knowledge and judgment, and has succeeded in condensing into small compass a considerable amount of information, much of which is drawn from sources not too easily available in Great Britam. The book is excellently written, well illustrated, and charmingly produced. We congratulate the author on having so admirably filled a real gap in our current scientific literature.

The Theory of Strong Electrolytes: a General Discussion held by the Faraday Society, April 1927. Pp iii + 333-544 (London The Faraday Society, 1927.) 15s. 6d. net.

The Faraday Society's general discussion on "The Theory of Strong Electrolytes," held at Oxford on April 22 and 23, 1927, was noted somewhat fully in these columns (May 7, p. 676). A full report, containing the original papers and the discussion upon them, has now appeared, and will be welcomed as a work of first-class importance on one of the most controversial aspects of physical chemistry.

## Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can be undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. No notice is taken of anonymous communications.]

### The Origin of the Nebulium Spectrum.

The identification by MM  $\,$  F. Croze and C  $\,$ Mihul of a number of intercombinations between quartet and doublet terms of O II (C R, vol 185, p. 702), which has been announced since my letter of last week was written, provides important data for the further consideration of Mi Bowen's suggestion as to the origins of certain lines in the spectra of gaseous nebulæ

Bowen's values for the quartet terms of O II were based upon a sequence of three  $^1P$  terms, and it was understood that while these were relatively correct among themselves, they were not necessarily quite correct with respect to the previously determined doublet terms. The discovery of intercombinations, however, leads to a correct relation between the two sets of terms. Without going into details, it may be stated that while Bowen's estimate for the  $^4S_2$  term was 283366 (*Phys Rev.*, vol 29, p. 243), the new data indicate a value of 283028, within limits of error depending upon the measurement of lines in the extreme ultra-violet. Thus, adopting Bowen's interpretation of the nebular lines  $\lambda 3728, \lambda 3726$ , we have

The mean value of  ${}^4S_2 = 283020$ , is in remarkable agreement with  ${}^4S_2 = 283028$ , as determined entirely from laboratory spectra, involving lines in the extreme ultra-violet. Taken in conjunction with the evidence in favour of similar irregular combinations of terms of N II and O III, this result leaves little doubt that Bowen's interpretation of some of the chief nebular lines is correct.

Since the ordinary combinations which build up the laboratory spectra of O II, O III, and N II do not occur in nebulæ, it would appear that the conditions in nebulæ which facilitate the occurrence of irregular combinations of deep spectroscopic terms are such as to prohibit the regular combinations which produce the familiar laboratory spectra of the same elements.

I should like to take the opportunity of making a small correction to my letter. In the paragraph on p. 582 in Nature of Oct. 22, beginning with "Bowen's assignment of the strong nebular lines  $\lambda 3728.91$  and  $\lambda 3726.16$  to O II leads to term values for  $^2D_{32}$  of the expected order of magnitude, and the consequent calculation of the red line  $\lambda 7325...$ ",  $^4S_2$  should have been substituted for  $^2D_{32}$ , and the word 'consequent' should have been omitted A. FOWLER.

Imperial College of Science, South Kensington, Oct. 19.

#### Absorption Bands of Ergosterol and Vitamin D.

WE have recently shown (Jour. Chem. Soc., 1927, p. 2000) that as the reaction

ergosterol 
$$\xrightarrow{\text{u.v. light}}$$
 vitamin D

proceeds, the characteristic selective absorption of ergosterol in the region 260-320  $\mu\mu$  diminishes in

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intensity at a uniform rate. At the same time a new selective absorption in the region 230-270  $\mu\mu$ , with a maximum at 247  $\mu\mu$ , gradually makes its appearance, and under our experimental conditions of concentration and light intensity the band is most clearly defined (that is, shows the maximum persistence) after 120-150 minutes' irradiation. Further irradiation now brings about the gradual disappearance of the band at 247  $\mu\mu$ . Animal experiments have indicated that preparations exhibiting this band show great antirachtic potency, whereas the over-irradiated samples are much less active.

As a necessary consequence of these results it follows. (a) that anything approaching a satisfactory yield of vitamin D requires prolonged irradiation, because the pro-vitamin bands disappear slowly, and (b) that the mercury vapour lamp is unsuitable for this particular photo-chemical reaction because it emits radiations capable of decomposing the product (vitamin D) Our assumption that the band at 247  $\mu\mu$  is due to vitamin D provides an explanation for the well-known instability of the vitamin to light, and unless this assumption is made, not only is the meaning of the band unknown, but we are also left without any physical mechanism for the photochemical decomposition of the vitamin

The absorption bands of ergosterol and vitamin D overlap to some extent in the region 230-270  $\mu\mu$ , so that the two substances will compete for these radiations. With a high concentration of ergosterol most of the energy at these wave-lengths will tend to form vitamin D rather than to decompose it, that is, the reactant will act as a screening agent hindering the secondary decomposition of the resultant. It is inevitable that the concentration of vitamin should rise to a maximum and ultimately fall to zero as the time of irradiation is prolonged, the exact value of the maximum depending on the initial concentration of sterol and the spectral distribution of intensity in the light source. We suggested that in order to obtain a high yield of vitamin, only rays longer than  $270 \mu\mu$  should be used, and m order to do so we stated that either the light from the mercury vapour lamp must be screened, or an alternate source used.

The conclusions (a) and (b) have been severely criticised by Messrs. Rosenheim and Webster (Lancet, Sept. 17, 1927) as not being in agreement with the results of their animal experiments. Indeed, these authors express the fear that their results involve the necessity for rejecting the 247  $\mu\mu$  band as a property of vitamin D, and they also issue a warning against the too-ready acceptance of conclusions based on spectrographic analysis. We are of the opinion, however, that our work supports in a most striking manner the results arrived at by them, and that these were indeed foreshadowed by the spectroscopic evidence. They find that under their conditions of irradiation a maximum antirachitic potency is reached after 30 minutes, this potency then remaining fairly constant for a further 210 minutes. By a roughly quantitative method they show, however, that at the end of half an hour only ten per cent. of the ergosterol has been removed, so that the maximum amount of vitamin D present at any time cannot exceed this figure. Actually, the quantity would almost certainly be less, since some must inevitably have been further changed into mactive material. How much this may be is unknown, as up to the present no quantitative relationship exists between vitamin D and antirachitic potency. Neither the animal nor the spectroscopic test is as yet able to express vitamin D in more than relative terms. Although we are wholly ignorant of the nature of the chemical change which occurs when vitamin D is formed (i.e whether the maximum yield could be 100 per cent. or only 25 per cent. provided no decomposition occurred), it still remains true that the presence of 90 per cent. of unchanged material is hardly consistent, from a strictly scientific point of view, with its efficient utilisation.

Again, Messrs Rosenheim and Webster find that even after 240 minutes' exposure, 10 per cent of ergosterol still remains in the irradiated mixture. Such a result is in complete accord with our observations that prolonged irradiation is actually necessary for the complete conversion of the ergosterol, irrespective of the ultimate fate of the vitamin. These spective of the ultimate fate of the vitamin. authors seem to have completely mistaken our contentions regarding the employment of the quartz mercury lamp. The spectroscope rendered it perfectly clear that vitamin D was formed from ergosterol by use of We would, however, the mercury vapour lamp again emphasise that as long as the light source contains radiations between 230-270  $\mu\mu$ , photodecomposition of the vitamin must ensue, and this will become the more rapid the more the screening effects of the original ergosterol is lost by its conversion into the vitamin

Mr. A. E Gillam, working with one of us (R.A.M.), has been studying the actinometric control of the irradiation process. Using the same concentration as was studied by Rosenheim and Webster, it was found that the persistence of the 247  $\mu\mu$  band remained constant over a long period. It has also been found that irradiation behind vitaglass screens does not effect the expected increase in vitamin concentration. While these results do nothing to weaken the argument for the validity of the correlation between the 247  $\mu\mu$  band and the vitamin, it must be concluded that there is still ample reason to justify us in pursuing the study of the irradiation process by spectrographic means. Finally, we would emphasise that our argument, which is based solely on the disappearance of the pro-vitamin D bands, is not affected if it be eventually shown that these are not due to ergosterol but to some constituent contained therein.

J. M. HEILBRON, E. D. KAMM, R. A. MORTON.

The University, Liverpool.

## Barrier Reefs of Tahiti and Moorea.

To answer completely the letter from Prof. Davis, published in Nature of Sept. 3, would take too much space, so, as he suggests, I leave my papers to speak for themselves when they appear. To explain the presence of basaltic stones on the 'barrier' reef by a filling in of the lagoon, and its re-excavation, is really a special pleading against the simpler hypothesis of a once continuous reef; I can myself suggest a much simpler alternative, namely, by their being floated across entangled in the roots of trees, floated out to sea by floods. I reject this means of transport, however, because the stones are invariably rounded, which could only be the case when the tree has been uprooted from an alluvial flat. The reefs and their embedded stones are certainly pre-glacial, when such flats were of small extent, especially if, as Prof. Davis holds, the valley mouths were drowned, and the stones, in the great majority of cases, could have been only angular fragments of the rocky sides of torrents.

I can assure Prof. Davis that the geological aspect in general, and his own work in particular, are fully recognised by all workers who, like myself, have been so greatly influenced by Prof. J. Stanley Gardiner, and his forthcoming book will be read with the greatest interest. At the same time biologists cannot agree that their contribution has been, or will ever

be, "the less significant side" of the problem, and I suspect that Prof Davis did not quite intend this meaning; the geological aspect is fundamental, but alone it is as dead as 'faith without works'. The mention of such names as Gardiner and Mayor is sufficient to prove the value of biology, but, as the present discussion is on the reefs of the eastern Pacific, it may be more interesting to take new, and as yet unpublished, examples from that region

The Marquesas have been the subject of much geological theory, but it was reserved for a biologist to find that the absence of reets from that group is a matter of coral ecology after all The foundation, growth, and recession of reefs cannot be completely understood without even more knowledge of the life of corals than we have at present. This subject is only at its beginning These basaltic stones scattered upon, and bedded into, the Tahitian "barrier" could never have been seen by a geologist, and I think their discovery may be a by-product of the long hours I spent during seventeen years inspecting pearl beds in the Red Sea Also the fact of the recession of these reefs is as interesting to the geologist as to the biologist, but it can safely be said that it would never have been discovered by the former. The importance of the origin of surf-resisting reefs, as distinguished from mere loose heaps of coral, has been insisted upon by Prof. Davis himself. This is decidedly a biological problem, depending upon the interaction of the stony seaweeds and other organisms with coral, as described by Gardiner, and it is also illustrated by the rejuvenated portions of the Tahitian reef edge.

Prof. Davis explains the occurrence of high cliffs on the north side of Moorea Island by a local delay in reef building through the outwash of alluvium from the two fjords of this coast. As he states, this alluvium would be carried westwards, and it would therefore affect only the western two-thirds of the coast, and the reefs would be markedly narrower westwards than they are to the cast, which is not the case. The uniformity of the width of the reefs is one of the curious features of the whole group, and those of Moorea well exemplify this. In my account of the Island I have taken the view that the straight north coast is faulted, the two fjord-like bays are due to explosions, while the south coast has tilted downwards and drowned its valleys. All this occurred early in the island's history and has had no effect upon the form of its reefs. I have no wish to make this a general statement, applicable to any other island.

general statement, applicable to any other island.

Agassiz gives no detail of his dredging in the Tahitian lagoons, and I have good reason for distrusting his general statements. My own dredgings . have been far too few, but the most enclosed of all the lagoons, from Papeete round the north-west quadrant of the island to Taapuna Pass, was thoroughly explored by dredge. Its sand is surprisingly uniform in character, angular and fairly coarse, and contains only 15 per cent. of non-calcareous matter. absence of the red mud, which is poured in at every heavy rain, is remarkable. I conclude that this lagoon is filling in, but much more slowly than I, for one, expected. Proof is wanting of what is happening at the bottoms of those lagoons of Tahiti which are certainly being excavated for the first few fathoms of their sides, and I hope to obtain it by a series of dredgings on my next visit. If at the same time some mexpensive borings could be taken (1) in the valley flats, (2) at the bases of the marine cliffs, (3) in the reefs, we should not be dependent upon inference for the discussion of the points raised by Prof. Davis, and by my own work. I do not reject the evidence for subsidence given by the valley flats, but pending positive information, they are as well

accounted for by lateral cutting of their streams as by the infilling of bays. Flat-bottomed valleys abound wherever a stream's load of alluvium is excessive, conspicuously, eg., among the mountains of the Red Sea Finally, I see no reason why subsidence should convert a fringing into a barrier reef, but, in Tahiti, see evidence that drowning would tend the other way, to the production of a wide flat.

CYRIL CROSSLAND.

The Zoological Laboratory. Cambridge, Sept. 2.

#### Earthquake Warnings.

In a letter in Nature of Oct. 13, 1923 (p. 538), I proposed a possible method of obtaining warnings of the occurrence of earthquakes. "It seems probable," I wrote, "that the rupture, whatever its nature may be, that gives rise to the actual vibratory shock of an earthquake is preceded by a strain or distortion of the earth's crust, which gradually increases till the stress that causes it is suddenly released. The existence of this strain should be evidenced by a progressive sag or tilt of the surface" I suggested that a new form of the Milne-Shaw seismometer, which has a fixed mirror, as well as the mirror attached to the pendulum, might be employed for detecting such a tilt, and that, "if it be found that shocks are in fact heralded by a definite tilt, it may be possible to arrange for an electric bell to attract the attention of the observer when such a tilt occurs. If he is satisfied that there is sufficient evidence of an approaching earthquake, a general alarm can be sounded."

At the meeting of the Geodetic and Geophysical Union at Prague in September, I had the good fortune to meet Dr. Akıtune Imamura, professor of seismology at the Tokyo Imperial University, and to learn from him that in Japan earthquakes have in fact been preceded by such tilting as I had suggested In his report to the Union (printed in Paris in the present year) he tells us (p. 7) that the Tango earthquake of Mar. 7, 1927, was indicated by an upheaval a metre at a maximum at Mitu and Sunakata, ie. along the coast in the east of the Gomura fault, attaining this state two and a half hours before the great shock took place, although the change was less pronounced on both sides of those places.

Similar phenomena were observed on the occasion of previous destructive earthquakes on the coast of the Sea of Japan. Prof. Imamura gives a table showing an upheaval before the shock in five earthquakes between 1793 and 1927. The maximum temporary elevation varied from one to two metres and preceded the actual earthquake by from half an hour to five hours. He concludes "that the assumption that topographical change precedes earthquake" (Dr. Imamura's italics)

may not be so absurd.

"Ishimoto's clinograph, which can register a tilting as small as a decimal of a second, registered at Tokyo a characteristic tilting which appeared from a few weeks before, to the day of the great Tango earthquake. Similar phenomena were observed with his instrument installed at Mıyadu, in the case of the shock on Apr. 1, the biggest of the after-shocks of the Tango earthquake."

"The Earthquake Research Institute of the Tokyo Imperial University is attempting to have, among others, a network of stations, each equipped with a pair of clinographs and other auxiliary instruments necessary for carrying on the study concerning the

earthquake prediction.

I am not aware that my suggestion has been acted on anywhere else.

It would seem desirable that, in regions subject to serious earthquakes, a number of local stations should each be equipped with a pair of simple horizontal pendulums, so adjusted that if any unusual tilt occurs a bell should ring automatically in the office of a central observer and the locality indicated there by He would then judge from the number of stations affected, and the record of his own seismometer, whether the indications were sufficient to wairant him in giving the alarm.

I may add that I am informed by Sir Gilbert

Walker that a slight tilt has sometimes been observed in the seismographic records of Simla setting in a few minutes before the vibrations from an earth-

quake with a comparatively near epicentre.

In conclusion, I should like to point out that the earthquake warnings to which I have been referring are quite distinct from long-period earthquake predictions based on observation of the secular relative movement of adjoining masses of the earth's crust. Such movement results in a stress in the tract intervening between them. When this stress exceeds the limit of elasticity of the rock, rupture will take place followed by an earthquake shock (H. F. Reid, Beitrage Geoph., vol. 10, pp. 328-345; 1910; J.W Evans, Q.J.G.S., vol. 66, p. 346; 1910). From such observations it may be possible to form some idea when the limit will be exceeded, and thus to predict the occurrence of an earthquake with an error of, perhaps, not more than, say, half-a-dozen years The actual disruption of materials under stress is, however, as is well known, immediately preceded by increased deformation, and it is the tilt that results from this that provides the earthquake warning. The interval between the commencement of the warning tilt and the shock is usually brief, but in most cases it will be long enough to enable loss of life to be largely, if not entirely, prevented.

The same report contains interesting details of the horizontal and vertical movements accompanying the earthquakes of 1923 and 1927 respectively. These are clearly shown in the maps and reproductions of photographs that accompany it.

JOHN W EVANS.

Athenæum Club, London, Pall Mall, S.W.I.

### The Consistence of Mixtures of True Fluid and of a Fluid with Solid Particles.

When two fluids which have no chemical action on one another and are mutually insoluble, are well shaken together, the mixture consists of small globules of one fluid embedded in a matrix of the other, and is in general less fluid than either of the constituents taken separately. Common examples of this sort of stiffening are to be found in cream, mayonnaise sauce, and butter (mixtures of oil and watery fluid), but the most striking case is that of oil and mercury, which forms a stiff black mud. In the first three examples it is the oil which takes the globular form, and in the last the mercury.

Since the surface tension of oil-water is much less than that of mercury-oil, it would seem that the surface tension difference is not the factor determining which of the two fluids shall persist as globules. This probably depends on the qualities which tend to make fluid films stable The stiffening of these mixtures may be explained by the fact that when they are stirred or distorted, a flow has to take place in the narrow channel separating the globules and that this is resisted by viscosity.

Suppose that a large number of small solid spheres are placed in a vessel, and are so disposed as to occupy

the minimum space (i.e. that each is touched by its neighbours at twelve equidistant points), and that then fluid is added until the spheres are just covered If now the arrangement of the spheres is disturbed in any way, the level of the fluid will fall in consequence of the increase of the volume of the interstical cavities, and the viscous resistance to be overcome is proportional (among other things) to the aggregate surface of spheres-or, in other words, inversely as their diameter.

When the spheres are globules of liquid, distortion of the mass will also cause a deformation of the individual globules, and this will be resisted by an elastic reaction due to the internal pressure, which exists in them by virtue of surface tension. The internal pressure in a globule of diameter D where the surface tension constant is T is equal to T/D, and this becomes considerable when D is small a mercury-m-oil globule, for example, if D is 1/2000 in the pressure will exceed 40 lb per square inch—about as much as the pressure in an ordinary bicycle tyre, but in a collection of such globules, if deformed, the internal pressure may be much greater, for the deformation tends to make the globules into dodecagons, and the pressure is inversely proportional to the least radius of curvature of the deformed sphere. (In such fats as butter, in which the oil solidifies at low temperature, additional viscous resistance is offered to deformation.)

It would be a waste of space to go fully into the quantitative (and fairly simple) relations between volume of the interstices as the arrangement of the globules departs from the minimum volume pattern, but the results may be shortly stated thus:

(1) In a collection of fluid globules closely embedded in a second fluid, resistance is offered to deformation by a force which is partly elastic and partly viscous, the viscous force being much the more important.

(2) The resistance increases as the diameter of the

globules diminishes.

(3) When the globules are closely packed any deformation of the mixture involves an increase of volume, not, of course, of the globules, but of the

spaces between them

The expansion of mixtures from this cause is well shown in such material as glazier's putty (oil and chalk). Putty when well kneaded is soft, and if rolled into a cylinder can be easily lengthened or shortened for a certain distance by applying force to the ends. If, however, the alteration of length exceeds a definite limit, the resistance increases very rapidly, as if the motion were opposed by a mechanical stop. At the same time, the appearance of the surface suddenly changes, losing its shiny gloss and becoming dull and 'matt.' This happens when the particles of chalk, which at first were separated by oil, have been brought into contact, and further distortion withdraws the oil from the surface to fill the enlarged internal cavities. The same explanation applies to the dry patches which (as most people must have observed) appear for a short time round footsteps on wet sand recently left by the tide. Most people also must have noticed that by tapping on the sand with the foot, the surrounding area becomes wet and softa quicksand in fact—thus showing that the sand particles are separated by fluid, but the wet area quickly resumes the dry appearance when a steady pressure is applied.

Many superstitions have collected about the character of real quicksands, and it would be a matter of interest to examine the conditions under which they are formed.
9 Baring Crescent, A. MALLOUK.

Exeter.

The Thickness of the Continents.

This important datum, as arrived at on seismic evidence, has been referred to frequently in the pages of Nature Most readers, I think, will agree that the conflicting character of the results is discouraging. Within the last two or three years the average depth of the continental layer has varied from 12 to 60 km.

There is little doubt that the most trustworthy information available is that based upon isostasy. The object of the present letter is to direct attention to an important paper by Alfred Wegener in the current number of Gerlands Beitrage zur Geophysik (Bd. 17, H. 3), which bears directly upon the isostatic method of estimating continental thickness and, as I think, involves a correction upon

all previous calculations based on isostasy.

In the course of a discussion of Gutenberg's conclusion as to the existence of a great depth of sial spread over the Atlantic floor, Wegener points out that the average depth of the ocean should not be taken as defining the surface of the sima but, rather, those soundings which are found to prevail over the greatest areas. The 'Haufigkeits Maximum,' so far as the observations go, defines a depth of about 4700 m, and he considers that further knowledge of ocean depths probably will refer the sima surface to a depth of about 5000 m. The lesser soundings obtained over the ocean are to be ascribed to the presence of more or less sial, which floats in the denser sima. In the Azores such oceanic sial attains the surface. There are considerable areas in the Atlantic floored by such submerged plateaus and islands but, also, great areas floored by sima as indicated by the greater depths. In the Pacific the sial is absent or scarce.

This interpretation of oceanic soundings commends itself as almost certainly correct. We must accept it if we are to remain true to isostasy and profit by the results obtained by Meinez over great ocean areas: results brought before the recent International Union of Geodesy and Geophysics (NATURE, Oct. 1, p. 494).

Wegener's interpretation of the soundings directly affects our application of isostasy to finding the average continental thickness, as he, himself, recog-Thus, some few years ago I sought to estimate continental depth on isostatic grounds. taking the mean depth of the ocean (3.8 km. Murray) as defining the surface of the sima. The thickness came out as 30.7 km. ("The Surface History of the Earth," p. 35). The other data m volved the average density assigned generally to continental materials, that is, that of granite (2.67) and that proper to the substratum, that is, that of basalt (300); it being further assumed that pressures and temperatures prevailing in the depths leave the ratio of these densities unaffected. But in this calculation the average emergence of the continents over the surface of the sima is taken on the prima facie plausible assumption that the mean depth defines the surface of the latter. Correcting the figures m accordance with Wegener's views (as above) the average continental thickness is found to be 37 km.

This result appears to possess the minimum degree of uncertainty. The thermal methods cannot be regarded as sufficiently dependable to over-ride it. For, in fact, it may well be that the radio-activity of the continents diminishes somewhat downwards as itappears to do in the whole depth of the substratum so far as we can ascertain. Such a diminution in radio-activity would probably be attended with some increase in density. But the latter change may be small. Thus if anorthosite, which Daly regards as probably a gravitative differentiate of gabbroid

(basaltic) magma, entered considerably into the basal structure of the continents, the radio-thermal effects would seem to be reduced some fifty per cent. and the density be only slightly affected. If diorites shared in the deeper continental structure (as Holmes has suggested) the same effects would arise, but in

lesser degree.

It would seem that upon the thermal aspects of the question all we can say is that our estimates point clearly and unmistakably to basal temperatures adequate to annul or greatly reduce escape of heat from the underlying sima or, even, possibly to give rise locally to some downward flux. and that as regards surface gradients the data are so uncertain that beyond their testimony to the continued ascent of heat from beneath in amount sufficient to support and confirm our views as to its radioactive origin throughout continental materials of relatively high J. JOLY. radioactivity—we cannot go.

Trinity College, Dublin, Oct 3.

## Dug-out Canoe in Algoa Bay.

MR F W. FITZSIMONS has sent me a fragment of wood from the dug-out canoe washed ashore in Algoa Bay, described by him in NATURE of May 21, and since referred to by other correspondents in these columns. I am naturally far from desirous of entering into the discussion on the exact origin of the canoe, but the results of my examination of the wood show, I think conclusively, that the canoe had its origin somewhere in the Bay of Bengal off the coast of Burma or the Malay Peninsula, and that the Nicobar Islands cannot have furnished the particular timber from which it was made.

Examination of the fragment received from Mr FitzSimons shows that the wood is derived from an Indo-Malayan tree of the family Anacardiaceæ. The anatomical structure, which is quite distinctive, identifies the specimen with one of two closely related genera, Gluta and Melanorrhea. Species of both these genera are distributed throughout Indo-Malaya and are represented in the Mergui Archipelago by Gluta tavoyana Wall. and Melanorrhæa glabra Wall, but so far neither genus has been recorded from the Nicobar Islands. A study of specimens or descriptions of all the genera of the Anacardiaceæ represented in the Nicobar Islands has not revealed any indigenous wood which bears more than a tamily resemblance to the timber of the canoe.

B J. RENDLE. to the timber of the canoe.

Imperial Forestry Institute, University of Oxford.

## An Aspect of the Biochemistry of Sugars.

THE ISSUE of NATURE of July 9, p. 44, contains a communication by Prof. R Robinson, in which, on purely speculative grounds, far-reaching conclusions are drawn (1) regarding the origin in Nature of galactose, and (2) regarding the configuration of the pentose of the plant nucleic acid. The second conclusion met with the approval of Haworth.

The views of Prof. Robinson are contradicted by

recorded facts.

(1) Glucose-3-phosphoric acid ferments at the same rate as glucose. Should glucose-3-phosphoric acid on hydrolysis pass into allose, then the rate of fermentation would be lower than that of glucose. Glucose-6-phosphoric acid (very stable ester) ferments at a lower rate than glucose.

(2) In the pentosephosphoric acid of the yeast nucleic acid, the phosphoric acid is attached to carbon atom (5) which is symmetric.

Furthermore, Dr. A. L. Raymond and the writer have found that on hydrolysis of glucose-3-phosphoric acid, only one sugar, namely, glucose, is obtained.

A more detailed analysis of Prof. Robinson's communication will be published in the Journal of Biological Chemistry in connexion with the report on the hydrolysis of glucose-3-phosphoric acid.

P. A LEVENE.

The Rockefeller Institute for Medical Research. New York, Sept. 16.

#### The Isolation of Protoactinium (Element 91).

THE exact relation of the actinium to the uraniumradium disintegration series has been a matter for discussion since the discovery of actinium. A. S. Russell (NATURE, Sept. 17, p 402) has recently discussed the problem and made a new attempt to predict the atomic weight of the longest-lived member of the series, protoactinium. He mentioned that experimental verification of the suggested values was difficult owing to the great difficulty of separating protoactinium from tantalum.

Recently it has been shown in this laboratory that the separation of protoactinium from other elements is · not so difficult as has been thought, and about 2 mg. of almost pure oxide of protoactinium has been isolated. An account of this will shortly be published. The half-value period of this product has been redetermined by O. Hahn and E. Walling as 20,000 years For each gram of radium, therefore, in a mineral

there is approximately 0.4 gram of protoactinium.

It is hoped that the difficulties, both financial and technical, of preparing a sufficient quantity of the element for an atomic weight determination will soon be overcome so that this outstanding problem of radioactivity may be settled.

ARISTID GROSSE.

Abteilung Hahn-Meitner, Kaiser Wilhelm-Institut für Chemie, Berlin, Sept 27.

## Formation of Anthraquinone by Vapour-phase Oxidation of Toluene, and Toluene-containing Petroleum Distillates.

The recent paper of C R. Downs (Jour. Soc. Chem. Ind., 46, 383T; 1927), stating some facts and also speculations concerning catalytic oxidations, is of much interest, and we wish to confirm the interesting oxidation and condensation of toluene to anthraquinone. Experimental details of most of these vapour-phase reactions are almost entirely lacking, the processes being covered by numerous patents.

We have obtained small amounts of anthraquinone with benzoic acid and benzaldehyde by passing air mixed with toluene vapour, or the vapour of a toluenecontaining petroleum distillate, over a catalyst consisting of aluminum grains coated with vanadium pentoxide. The gas rate used was about 12 litres per hour, and the catalyst maintained at 400° C. The gas mixture was obtained by bubbling air through the toluene held at 50° C. The greater portion of the anthragumone and benzoic acid formed under these conditions crystallised out in the cooler parts of the exit end of the catalyst tube.

A. R. BOWEN. A. W. NASH.

Department of Oil Engineering and Refining, University of Birmingham.

## Causes and Effects of Mining Subsidence.

By Sir Richard Redmayne, K C.B

THE final report of the Royal Commission on Mining Subsidence, appointed on Mar. 17, 1924, has recently been published. The Commission was asked to inquire into the operation of the law relating to support of the surface by underlying minerals, the extent and gravity of the damage caused by subsidence owing to the extraction of minerals, and to report as to what steps should be taken by legislation or otherwise to remedy equitably the hardships that may arise in existing conditions—a wide and controversial field—and Lord Blanesborough, the chairman, is to be congratulated, not only in securing unanimity, but also in having presented an admirable and lucid

The subjects of the report, which is concerned almost exclusively with the coal-mining aspect of the case as "the extraction of other minerals presents in this country no feature sufficiently outstanding to call for separate attention" at their hand, are considered under convenient heads which allow of the matter being easily and quickly digested. To the technical expert, perhaps, the matter dealt with under the earlier headings is the most interesting, namely—the physical aspects of subsidence, and the uncertainty of its incidence, as well as the definition of the problem before the Commission, the legal position. The definition given of subsidence is worth reproduction in view of some of the decisions that have been arrived at in the Law Courts. "Where," says the report, " a seam of mineral is completely extracted the unsupported roof falls If the overlying beds consist of comparatively soft strata, these will bend down gradually and fill the void almost completely, and the superincumbent beds will come down in turn until the subsidence reaches the surface. In every case the descent of the superincumbent strata is accompanied by more or less fracturing and, therefore, by an increase in the volume of the strata thus let down. It follows that the surface subsidence is never equal to the thickness of the mineral extracted.'

The full meaning which is meant to be conveyed by the words, "where a seam of mineral is completely extracted," is not clear. Literally interpreted, they would mean that the area of extraction involved would extend over the whole coalfield. The sentence should have read, "where a certain area of a seam of mineral is completely extracted." What that area has to be before subsidence commences has been a source of much argument in the Law Courts and elsewhere, is subject to variation, and is largely determined by circumstances, such as the thickness of seam worked, depth of the seam from the surface, inclination and nature of the strata overlying the seam, and the presence of faults. To maintain, as was asserted in a recent classic law case, that, on

<sup>1</sup> Second and Final Report of the Royal Commission on Mining Subsidence, Pp. 68, (London: H.M. Stationery Office, 1927.) Price 1s. 3d. net.

extraction of a coal-seam (only very small temporary support being left by odd pieces of coal which were left in the process of working), the roof, consisting of a strong bed of sandstone, would bend, and eventually a period of quiescence be attained without the roof and floor meeting, is a most erroneous view, but one more widely held than is generally supposed. It is pleasing, therefore, to find the Commission upholding the correct view and stating that the roof in such a case will break into comparatively large blocks which, piling up irregularly on each other, afford at the outset a certain measure of support to the overlying beds The presence of these beds gradually crushing down partly reconsolidates the broken blocks, and in this way the subsidence ultimately reaches the surface. The movement, too, continues longer, and the total amount of surface subsidence is less than when the superincumbent strata consist mainly of softer and more plastic rocks.

The Commission arrives at the conclusion that the amount of subsidence is not quantifiable and "cannot be predicted with any accuracy, even when all the conditions are tolerably well ascertained." I should hesitate to be so positive as this. Given the thickness of the seam, the method of working practised, the nature and thickness inclination of the superincumbent strata, it should be possible to arrive at a fairly close approximation, not only as to the amount, but also the period of the subsidence consequent upon extraction of the underlying mineral

The "problem of damage" from subsidence, as regarded by the Commission, can perhaps be epitomised thus

1. It may be better in the national interest in some cases to leave minerals unworked than to work them, for example, in such a case as where lowering the surface would cause the land to become a swamp

2. The determination of cases in which a remedy is called for where damage has been done to the surface and building, etc., where the owners have no claim for redress or compensation under existing conditions.

Most people are under the impression that the right of surface support is universal, but such is not the case. The right of support to the surface may have been lost through severance at some time of the ownership of the minerals from the ownership of the surface, but "unless the power to let down the surface be found in the instrument of severance," said Lord Swinfen (MR. 1915, 1 ch. 264), "and unless the power to let down the surface be found there expressly or by necessary implication, the common law of right of surface owner to support will prevail." Conveyancers in settling instruments of severance have devised provisions unambiguous in respect of power to

let down the surface, so there exists to-day in Great Britain a class of surface owner who has no right of support of the surface Again, the introduction of the Mines (Working Facilities and Support) Act, 1923, excellent measure though it is, has erected machinery for the purpose of enabling minerals to be worked irrespective, speaking generally, of the resulting effect upon specific surface property, and notwithstanding that, apart from the Act, the surface is entitled absolutely to support. In such a case the owner is entitled to, but he must be content with, pecuniary compensation.

The Commission recommends that private owners or occupiers of dwelling-houses of an annual value not exceeding £40 be entitled to compensation for damage to property arising from subsidence due to the extraction of adjacent minerals, such damage being manifest at the time of or subsequent to the passing of an Act allowing compensation, the compensation to be recoverable from any person who has worked the minerals under or adjacent to the house, which impresses one as being a wise and fair solution. The statement of the legal position, and the arguments which have influenced the Commission in arriving at this decision, are set out with admirable clearness and precision, and should be read with care by all of those interested in the subject, whether mining engineers, local authorities, lawyers, or property owners.

The remarks under the heading "Methods of Mitigating Subsidence Damage" are particularly interesting to the mining engineer Upon this aspect of the matter the report considers three suggestions, namely:

- (a) The hydraulic stowage of the excavated areas and more scientific methods of mining.
- (b) The scientific lay-out of the surface; and
- (c) Precautions possible in the construction of surface buildings.

As to the first, the conclusion is reached that the universal adoption in Great Britain of the filling of the mine wastes with débris under hydraulic pressure—a system so largely practised in the Pas de Calais, the Westphalian, and some other continental coalfields—is impracticable, chiefly because of the cost, a conclusion which was also arrived at a few years ago, for a similar reason, by the Government Committee on Spontaneous Combustion in Mines, of which the present writer was chairman. Except in a very few areas, such as South Staffordshire, where the circumstances in respect of the presence of the necessary material and underground conditions are more favourable to its introduction—at Motherwell, in Scotland, where it is being advantageously employed, the cost is estimated at 1s. 3d. per ton of coal raised.

Under a system of longwall working with regular advance of an even face and close and systematic packing of the goaf or waste, the subsidence resulting from the extraction of the coal is less than under the irregular working of coal. The longwall system is not, however, always practicable, for example, in the case of a very thick seam.

The disadvantage of erecting houses in long terraces, and the advantage of building them in blocks of two or four instead, is pointed out "The more scientific 'zoning' and development of the surface according to current conceptions of Town and Regional Planning should also do much to mitigate the damage caused by subsidence"

Under the third suggestion the Commissioners are impressed by the view expressed by Dr. Faber, who gave evidence before them, namely, that ordinary brick buildings would suffer much less from subsidence if lime mortar were replaced by cement mortar, the tensile strength of the latter being many times greater, the increase in cost not amounting to more than two or three per cent. The ordinary miners' cottage, he considered, would be perfectly safe "if built of ordinary brickwork with cement mortar on a properly constructed ferro-concrete raft."

The interests involved are classified by the Commission under three heads, namely (1) The National Interest; (2) the Local Authorities; (3) Private Owners

Under the first the matter involved has already been touched upon, namely, the possibility in some cases of the surface being rendered valueless by its being lowered. The Commission has the Doncaster area chiefly in mind, and in accordance with the recommendations made prior to the issue of this, the final report, a Commission of Inquiry has been set up.

The interests of local authorities in respect of possibility of subsidence are chiefly concerned with waterworks and sewage works. The Public Utility Companies, the Statutory Tramways Companies, and the Statutory Gas and Electricity Companies are likewise involved. Under the Railway Clauses Act, 1845, it is assumed that subsidence only takes place, more or less vertically, above the mineral workings—an assumption which all mining men now know to be erroneous—and a limit of forty yards was imposed as the distance beyond which the workings should not approach the thing to be supported. It was considered that the forty-yards' limit gave ample support from subjacent minerals

The special code of the Support of Sewers Act is a modification of the code in the Waterworks Clauses Act, 1847, the main difference being that the Local Authority may specify any distance within which they require the minerals to be left unworked. The matter in respect of railways has been modified by the Mines (Working Facilities and Support) Act, 1923, the statutory distance being enlarged to one-half the depth of the seam from the surface—though this is not a 'scientific' distance—and provides payment by the mineowner of partial compensation for damage caused by his workings within the statutory distance in cases where the right to purchase support has not been exercised by the railway company. The Commissioners are of the opinion that the right given under Part 1 of the Mines (Working Facilities and Support) Act, 1923, to prohibit and restrict the working of minerals should be extended to Local Authorities and Statutory Undertakings, which seems to be only right. It is to be hoped, however, that a more scientifically defined limitation in regard to the extent of lateral support to be left from subjacent minerals

will be devised than that existing in respect of

The exigencies of space prohibit a longer dissertation on this most valuable and interesting report, which is a model of conciseness and clarity, and should be widely and carefully read.

## The Chemistry of Hormones.

THE British Association has the advantage over a number of specialist societies in that it brings together investigators in different branches of science. It makes good use of this advantage in the joint meetings of cognate sections and by discussions on the border line between two sciences. In framing his programme for the Leeds meeting, the recorder of Section B (Chemistry) must have had these advantages in view, for he secured contributions from a number of physiologists to a valuable discussion on Sept. 5 on the chemistry of hormones.

In opening the discussion, Prof. G. Barger (Edinburgh) began by explaining what is meant by a hormone. In contradistinction to the longknown method of stimulation by a nervous impulse, Bayliss and Starling first recognised, in the case of secretin, that a stimulus may also be brought about by a chemical messenger or hormone, set free in one organ and travelling through the blood stream to another organ which is then excited to Thus the hormones are highly active and highly specific drugs which the body elaborates for its own uses. The preparation and study of the hormones is therefore of the greatest importance to medicine, since they may produce effects quite unobtainable by the ordinary vegetable or synthetic drugs. The recent introduction of insulin in the treatment of diabetes is a case in point.

With the aid of lantern slides, Prof. Barger illustrated the course of development of our knowledge by reference to the two hormones which have so far been synthesised, adrenaline and thyroxine. There is first the recognition by the clinician or physiologist of the importance of the organ producing the hormone. In the two cases mentioned, this was followed by the discovery in it of some chemical peculiarity (chromogen in the adrenal gland, iodine in the thyroid). The biochemist then attempts the isolation of the active substance in a state of purity, and when this has been achieved, the organic chemist can investigate the molecular structure of the hormone and finally synthesise it; when the physiologist certifies the synthetic product to have the same degree of activity as the natural substance, some degree of finality has been reached.

For this reason Prof. Barger did not deal with the constitution and synthesis of adrenaline and thyroxine as choses jugées, but focussed attention on the crystalline substance of high molecular weight, obtained recently from commercial insulin by Abel and his co-workers, and having in a high degree the physiological activity characteristic of this hormone. The substance can be recrystallised

and retains its activity; indeed, the residue left on evaporation of the mother liquor is, weight for weight, much less active than the crystals. This would constitute a prima facie claim that insulin has thus been obtained in a state of chemical purity, but Abel, aware of the pitfalls which beset investigations of this kind, himself suggests the alternative, that the crystals may carry down "an unknown substance of almost unbelievable potency." The carrying down of insulin by a crystalline precipitate of a much simpler substance, benzoic acid, formed in its solution, has actually been used in the manufacture of insulin.

Prof. Barger directed attention to the analogous difficulty in appraising the recent work of Jansen and Donath, who described the isolation of the enormously active vitamin from rice polishings. These authors crystallised a hydrochloride from acetone and alcohol, converted it into the crystalline picrolonate and gold salt, and passed back from these to the original hydrochloride without loss of activity. Here adsorption would seem to be excluded. In the case of insulin the substance can only be crystallised from water in the same way as it is formed originally, i.e. by the careful addition of ammonia to a highly buffered solution.

The subsequent discussion showed that this method did not entirely satisfy organic chemists. Prof. J. L. Simonsen compared it to the precipitation of barium sulphate; Prof. J. Mellanby pointed out the analogy to the crystallisation of proteins. A letter was read from Mr. F. H. Carr (unfortunately prevented from being present); he had carried out the crystallisation according to Abel's directions but found that the crystals were only one and a half times as active as the starting material (the ordinary commercial product of British Drug Houses, Ltd.). Others have also considered that the low potency of Abel's crystalline substance raises doubts as to its purity. This is, however only an argument drawn from analogy; pure insulin may be less active than other hormones, and the only ways of settling the matter would seem to be, either to get the same crystals with a much smaller potency, or to synthesise them; the latter would be a formidable undertaking.

Prof. Barger ended by putting forward a theory of the action of adrenaline and related amines, based on their adsorption by lecithin. He imagined the amino group of the hormone to be attracted by the phosphoric acid residue and the residual affinity of the acidic phenolic nucleus by the basic choline grouping; this would explain the optimal length of the side chain of two carbon atoms, the favourable effect of a phenolic hydroxyl, etc.

Prof H. S. Raper (Manchester) dealt next with the possible mode of formation of adrenaline in the organism. Although the organic chemist has disposed of adrenaline by synthesis, there is still work for the biochemist. Tyrosine appears to be the only possible precursor, and recently he has shown that this amino acid is actually changed by an animal oxidase to a catechol derivative, dihydroxy phenyl alanıne. The latter is then converted to an indole derivative, which might, however, not occur if the amino group is substituted.

Prof. J. C. Drummond (London) referred to the enormous activity of irradiated ergosterol in preventing rickets In his laboratory as little as 0 5-1 millionth of a milligram per day has lately been found sufficient for 100 grams of rat isolation of hormones is rendered difficult by a similar great potency. He referred to Abel's extremely active tartrate of a pituitary active principle, and to the fact that the same organ may produce several substances with different physiological actions Similarly, the investigation of the ovarian hormone is complicated by the existence of a substance, 'anti-oestrin,' balancing the action of oestrin

Prof. E C. Dodds (London) discussed the ovarian hormone, which he has been unable to distil, as described for example by Frankel and Herrmann, he doubts whether the active substance is really volatile. (The later experiments of Hartmann and Isler, who distilled the purified hormone after treatment with acetic anhydride, would seem, however, to leave little doubt on this point.) Prof. Dodds also questioned whether the

ovarian hormone is a lipoid, and considered that it has a true solubility in water. He referred to experiments with solutions of adrenaline in oil, which retained some pressor activity after shaking with dilute hydrochloric acid. In any case the chemical purification of the ovarian hormone does not seem sufficiently far advanced to draw many conclusions as to its chemical nature.

Prof J. Mellanby (London) described his experiments on the purification of secretin, which have resulted in an intensely active preparation, free from depressor substance. Contrary to Bayliss and Starling's view, that secretion is liberated from a 'pro-secretin' by acid hydrolysis, Prof. Mellanby considers that the substance is merely set free from an adsorption compound and in the normal process of digestion becomes fixed on bile acids. It is by adsorption on these acids that he has been able to effect so considerable a purification Adsorption (on fuller's earth) is also the most effective preliminary stage in the purification of vitamin B. Although highly active, Prof. Mellanby's secretin is not yet chemically pure, one of its most significant properties is the absence of any reaction with ninhydrin

In the general discussion, Dr. N. V. Sidgwick (the president of Section B), Prof. J. L. Simonsen, Dr T. A. Henry, Mr. H. J. Channon, and others took part, Prof. G. Barger replied. It was generally felt that the discussion had been valuable in bringing chemists and physiologists together to consider debatable border-line problems on which their outlook is apt to differ with the nature of

their studies.

## Obituary.

Prof. A. Liversidge, F.R.S.

THROUGH the death on Sept. 26 of Prof. Archibald Liversidge, science in Australia and New Zealand has lost one of the best and most unselfish of its friends. His death, due to heart trouble, in his eightieth year, came as a shock to his many friends, for even up to within a week or two of his decease he had always enjoyed robust health, and was exceptionally hale and hearty for his age. His nearest of kin surviving are his sister, Mrs. Balfern, of Buxted Lodge, Bexley, Kent, and his nephews Rear-Admiral E. Liversidge and Rear-Admiral J. G. Liversidge.

Born at Turnham Green in 1847, after studying at a private school and with tutors, Liversidge entered the Royal School of Mines and Royal College of Chemistry. Among his teachers were Frankland, Tyndall, and Ramsay. He gained an open scholarship in natural science at Christ's College, Cambridge, in 1867; and he was one of the two first students to work in Sir Michael Foster's physiological laboratory. After having been instructor in chemistry at the Royal School of Naval Architecture, he was appointed in 1870 demonstrator in chemistry at Cambridge. In 1873 he was elected to the chair of chemistry at the University of Sydney, a position which he held until

1908. He at once threw himself whole-heartedly, and with singleness of purpose, into the scientific life of his newly adopted country. His great energy, meticulous method combined with a breadth of outlook, a shrewd financial acumen and a keen desire to serve science for its own sake, at once marked him as a coming organiser.

Liversidge originated the Faculty of Science at the University of Sydney in 1879, serving as its dean from that date until 1904, and the University School of Mines in 1890 Thanks to him also the Royal Society of New South Wales now owns a fine scientific library and a valuable building as The first great impetus to technical education in New South Wales came largely from Liversidge, when a Member of the first Board of Technical Education at Sydney. As trustee of the Australian Museum, Sydney, from 1874 to 1908 he rendered invaluable service in helping to get together their fine collection, in greatly adding to their library, and in helping to secure for them their present fine building.

In 1885, Liversidge accomplished his greatest work in founding the Australasian Association for the Advancement of Science. Even those who know the relative isolation of scientific workers in Great Britain and Ireland previous to the founding of the

British Association can scarcely realise the extreme isolation of Australasian scientific workers separated from one another by distances as great as from London to Constantinople As in the case of the British Association, so, and even more so in the case of the Australasian Association, the crowning triumph of the work has been the bringing together for personal interchange of thought of so many remotely separated scientists

In regard to Liversidge's work at the University, as a teacher he was always remarkably successful and impressive with his practical demonstrations and lecture experiments Starting with very small buildings and next to no equipment, he was able, when he retired from the chair in 1908, to hand over to his successor, Prof Fawsitt, a large and flourishing school provided with laboratories, lecture-rooms, and equipment reasonably up to date in view of the great distance of Australian universities from centres of science in the old world

In spite of the time spent in teaching and organising, Liversidge's output of research work was considerable. His researches were directed chiefly to descriptive and experimental mineralogy. His chief published work was "The Minerals of New South Wales." He did much to stimulate interest in meteorites, collecting, analysing, and describing many Australian meteorites. Meteorites led him to study Australian meteoritic dust, especially the very finely divided red dust deposits which, in the hot dry climate of Australia, owe their origin to the transporting power of circular storms in the interior of the continent. He also published several papers on the origin and precipitation of gold, gold in solution in sea water, and the possible growth of gold nuggets in Australian alluvial

Altogether Liversidge contributed more than one hundred papers relating chiefly to chemistry and mineralogy, to the Chemical Society, the Royal Society of New South Wales, and the Royal Society of London. He made a hobby of acquiring minerals and meteorites, and his collections have frequently been displayed at exhibitions in Australia and in the northern hemisphere. Since retiring from the chair of chemistry at the University of Sydney, he continued until lately his researches at London laboratories. He was vice-president of the Chemical Society (1910 to 1913); vice-president of the Society of Chemical Industry (1909 to 1912); president of the Royal Society of New South Wales (1886, 1890, and 1901), president of the Australasian Association for the Advancement of Science (1888 to 1890); and vice-president of the British Association (1896). He was also a member of the Philosophical Society of Cambridge, of the Physical Society, of the Mineralogical Society of Great Britain and France, and he was elected a fellow of the Royal Society of London in 1882. Honorary degrees or memberships were conferred upon him by universities and scientific bodies, totalling thirteen in number.

Liversidge to the last was no less loval to Australia than to the mother country, and after his return to England he continued to correspond

overseas and to study carefully Australian journals, and if he found any matter needing his help either in Australia or New Zealand that help was freely given. Previously to the migration of Liversidge to Australia, the case of scientific men there might be described as that of quot homines lot sententiae, but after his years of residence there and the founding and fostering of the Australasian Association, men of science in Australia and New Zealand spoke with one voice, a voice which met with such a fine response in the visit to Australia of the British Association in 1914 and the Pan-Pacific Science Congress in 1923.

Liversidge's beautiful home and grounds, Fieldhead, Coombe Warren, Surrey, with the historie spring from which Cardinal Wolsey carried the water in large lead pipes all the way thence, with a dive under the Thames, to Hampton Court, was for many years past the Mecca of pilgrims of science from Australia There, too, he frequently entertamed—for he loved hospitality—not a few of his old colleagues whom he used to meet regularly at

the Athenæum.

One thing surely stands out among the many for which Liversidge will be gratefully remembered, and that is his splendid striving for the fraternity

" Frater ave atque vale." T W. E. D.

PROF. GOSTA MITTAG-LEFFLER, FOR MEM. R.S. The mathematical world is appreciably poorer by the death of Mittag-Leffler, of Stockholm, who died there on July 7 last. He was born at

Stockholm on Mar. 16, 1846

For the best part of his long life of eighty-one years, Mittag-Leffler had been a proud standard bearer in the extraordinary march of the theory of functions during the nineteenth century. How wonderful the progress has been we may realise by comparing the scope of some of the earliest with that of some of the latest publications. A sort of warning is given by the title of Lagrange's volume, dated Prairial, an V. (Second Edition, "Théorie des fonctions analytiques, contenant les principes du Calcul différentiel dégagés de toute considération d'infiniment petits ou d'évanouissans, de limites ou de fluxions, et réduits à l'analyse algébrique des quantités finies." But compare its contents with that of Weierstrass's posthumous paper, published in 1903, "Allgemeine Untersuchungen über 2n-fach periodische Functionen von n-Veränderlichen"; this is described by Mittag-Leffler as only a fragment of Weierstrass's "Losung des Rätsels dass sein ganzes Leben in Anspruch genommen hat," which remains, he says, in 1916, "noch eine ungelöste Aufgabe, eme der grossten, die den Mathematikern unserer Tage obliegt." Think of the contributions of Abel, of Cauchy, of Gauss, of Jacobi, of Riemann, of Weierstrass, of Poincaré, and of others, who, from the first recognition that the generally warrable the first recognition that the complex variable is the natural foundation of a general theory, have steadily erected a structure of constantly increasing grandeur and beauty.

Of all this progress in the branches of mathematics to which he was devoted, Mittag-Leffler was an enthusiastic observer, and, of its later phases, a conscientious historian, and he took upon himself the mission of fostering, in every way he could, amicable relations between mathematicians of different nationalities, and encouraging a disinterested pursuit of high intellectual aims, unaffected by any political or material bias With evident joy he tells how, three years after " la funeste année 1870 " " je vins à Paris suivre le cours d'Hermite; je n'oublierai jamais la stupéfaction que j'éprouvai aux premiers mots qu'il m'addressa 'Vous avez fait erreur, Monsieur,' me dit-il, 'vous auriez dû suivre les cours de Weierstrass à Berlin C'est notre maître à tous' Hermite était Français et patriote, j'appris du même coup à quel degré aussi il était mathématicien" But Mittag-Leffler was more than a standard-bearer of a mighty army; he was keenly anxious for the success of his subject He quotes Weierstrass's plea for the unity of all scientific endeavour, "Die einzelnen wissenschaftlichen Disziplinen erhalten ihre Bedeutung dadurch, dass sie alle zu diesem Zwecke mitwirken—in dem Mitund Nacheinandersein der Dinge Ordnung und gesetzmassigen Zusammenhang zu entdeckenaber nicht zusammenhanglos, sondern gleichsam eine Kette bildend" But he is aware of the conflict of his own subject with others whose aims have a more popular appeal, and when, in 1916, on his seventieth birthday, he devotes his house and library to the perpetual service of research in pure mathematics, he writes (Actu Math., 40), "Peu de gens, en dehors des spécialistes, comprennent l'importance et la mission des mathéinatiques pures," "un peuple que n'accorde pas aux mathématiques un rang élevé dans son estime, ne sera jamais en état de remplir les plus hautes tâches civilisatrices et de jouir, par suite, de la considération internationale"

Mittag-Leffler was the son of J O Leffler, headmaster of a secondary school, and of G. V. Mittag He was university lecturer in 1872 at Upsala, where he took his doctor's degree. After three years of travel (1873–1876) in Germany and France, he was professor of mathematics at Helsingfors until 1881, when he became professor at Stockholm (and Rector in 1885-6 and 1891-2). He resigned this post in 1911. In 1882, with an editorial staff of mathematicians from the four Scandinavian nations, and under the patronage of King Oscar II. of Sweden, he founded the journal Acta Mathematica, having noted, as he explains, that, after 1870, the German Crelle's Journal, and the French Liouville's Journal, had both ceased to have an international character. Of his own journal he remained editor in chief for forty years, until Vol. 40 (1925), maintaining, through this long period, it may safely be said, both the devotion to modern developments and the high standard set by Poincaré, in expounding his theory of Fuchsian functions in the early volumes. Special volumes were devoted to papers sent from all parts in commemoration of the

centenary of the birth of Abel (1902), a volume (38, 1921) was given to contributions by various writers in memory of Poincaré, and a volume (39, 1923, 258 quarto pages), written largely by Mittag-Leffler himself, is in effect a first hand critical history, of extreme value and interest, of the ideas associated with the names of Weierstrass and Poincaré. Beside the 57 pages dealing with the personal history and work of Weierstrass, this volume contains a paper of 65 pages largely composed of letters from Weierstrass to Sonja Kowalewsky Mittag-Leffler was in a good position to write, as he had collected the necessary documents over many years

The latter paper directs attention to another side of Mittag-Leffler's activity, and helps also to a better understanding of a book written by his sister, Anne Charlotte Leffler (Mme. Eddgren, and, later, Duchess of Cajanello); this is a biography of Sonja Kowalewsky, written in continuation of the autobiography of the early years of the latter; it is a book which every one who is interested in contemporary intellectual movements will have, or should have, read. It appears that after Mme. Kowalewsky had spent her four student years with Weierstrass (in continuation of her studies at Heidelberg), and was settled in Russia, it was suggested by Weierstrass to Mittag-Leffler, then in St. Petersburg, that he should call on Mme. Kowalewsky. The final outcome was that, very soon after Mittag-Leffler had been appointed professor in Stockholm, he took great trouble to open the way for Mme Kowalewsky to settle there as lecturer in mathematics Of his admiration for her personality, and of his feeling that he was doing a great thing for higher education, and for Stockholm, there is ample evidence—there is also evidence in Weierstrass's letters to Sonja of the regard which he had conceived for the personality of Mittag-Leffler. The end of the experiment at Stockholm is given in graphic phrase in the book referred to The gist seems to lie in A Ch Leffler's description of Sonja's "ardent besom d'intimité intellectuelle, et de la souffrance intense que lui causait le sentiment de la solitude . Le travail par lui-même, la recherche abstraite d'une vérité scientifique, ne la satisfaisant pas, il fallait qu'elle fût comprise, devinée, admirée, encouragée à chaque pas, à chaque nouvelle idée qui naissait en elle . . . Mittag-Leffler disait souvent à ce sujet, que ce besoin d'être comprise était chez Sophie une faiblesse de femme; un homme de génie ne dépend jamais ainsi de la sympathie des autres '

It will be gathered from what has been said how important was the service of Mittag-Leffler, as a link, as a sort of gracious master of the ceremonies, for one aspect of modern mathematics, it were to be wished that in England we gave more of the reverent care which animated him, to the historical and personal side of the development of the subject. His own personal contributions to the theory of functions need no long comment here. One of his

<sup>1 &</sup>quot;Souvenirs d'enfance de Sophie Kovalewsky, suivis de sa biographie" (Hachette, 1895). Also in Swedish, German, and English (Walter Scott)

papers, dealing with the formation of a function of which the behaviour at its singular points is specified a priori, was the occasion for a paper presented to the Berlin Academy, in association with the name of Mittag-Leffler, by Weierstrass. It is perhaps opportune to remark that the intimately related construction, by Weierstrass, of an integral function with given zeros, which one might naturally have thought to be suggested by Gauss's factorisation of the gamma function, was given only in 1874, when Weierstrass was fiftynine years old (letter to Sonja Kowalewsky, Acta Math, 39, 151). and that the form of Gauss's factorisation which exactly suggests the general

theorem was given in 1848, by F W Newman, in the Camb and Dublin Math Journal, 3. This was remarked by the late G B Mathews in the pages of Nature, long ago; it is not referred to by Mittag-Leffler in dealing with Weierstrass's early investigations (1843, 1856) on the analytical Facultaten. Another matter of a different kind occupied Mittag-Leffler in a series of papers: the expression of a function, with singularities for finite values of the independent variable, in a form which is valid over the whole plane as dissected by lines passing to infinity from the singular points of the function. Other papers, many written in Swedish journals, are not as yet so well known

## News and Views.

AGRICULTURE is the oldest of the chemical industries. The business of feeding man and his friends has, fortunately, been able to jog along for a very long time without entering into any close relationship with synthetic chemical industries other than that carried on so universally and so successfully by certain of the lower organisms of the soil. There has, moreover, been a disinclination to apply some of the new knowledge that has been placed at the service of the farmer, it being dismissed as being of little consequence when compared with the accumulated practical experience of generations on the land. Doubtless, too, the lack of consideration has not all been evidenced on one side However this may be, it is a fact that we cannot continue indefinitely to live on the reserve fertility of the virgin plains of the earth. Sir Alfred Mond, in an address read before the delegates to the Imperial Agricultural Research Conference at Billmgham on Oct. 18, based his remarks on this truism, and on the part which synthetic chemical industry must play in the future development of agriculture. So far as the British Empire is concerned, the economic aspect of the situation is no less considerable than the scientific. As was pointed out in the address, for many years Europe has paid to South America millions upon millions of pounds for nitrogen in the form of guano or of sodium nitrate. Imperial Chemical Industries, Ltd., has set itself the ambitious task not only of supplying the whole Empire with fertilisers, but also of acquiring and disseminating information concerning their application to soils of varying qualities and varying needs.

NITRAM, LTD., the selling organisation which has been set up to deal with the new synthetic fertilisers, has, said Sir Alfred Mond, already instituted a free and disinterested advisory service to farmers. It has also established a research station, with upwards of 400 acres of farm lands, where problems relating to the use of fertilisers and to the feeding of stock are to be investigated. The activities at Billingham, however, will not be confined to the manufacture of simple synthetic nitrogenous fertilisers, but will extend to the production of compound fertilisers, containing nitrogen, phosphorus, and potassium—the three chief plant foods—according to the demands of experi-

ment and experience. Naturally, the fertiliser requirements of the British Isles will be the first to receive attention.

A Careful consideration of Sir Alfred Mond's address leads one to the conclusion that, although he had no startling or even new thesis to present, he was able to show that Imperial Chemical Industries, Ltd., fully realises the nature of the problem—that of most effectively using chemical and mechanical knowledge in the multiplication of the fruits and riches of the earth—in its future as well as in its present aspects, and that the organisation is solving it in a patriotic as well as in a commercially successful manner. It is not merely a question of there being so many more mouths to feed and bodies to clothe each year. Neither is it entirely a question of meeting a demand for a more varied food supply; for satisfying the requirements of a generation better instructed. than its fathers in the relation of diet to health. There is also an increasing demand from the chemical industries themselves for new material. The artificial silk industry is a case in point; the alcohol motorfuel industry is another; and man has only just begun to learn the rules for training bacteria, in 'commercial numbers,' to do his will.

THE Slaughter of Animals (Scotland) Bill, which comes before the House of Commons for its third reading on Nov. 15, provides for the licensing of slaughtermen in order to check unskilful slaughtering, and for the stunning of animals with a mechanically operated instrument before slaughter. At the committee stage considerable concessions had to be made to the opponents of humane slaughtering: the effect of the bill was restricted to slaughter-houses and knackers' yards, swine were exempted from the operation, and the usual exemption for Jewish slaughtering was introduced. While the first two, at least, of these concessions will be generally regretted by humanitarians, there can be no doubt that they were wisely made, for in exchange the opponents of the bill have undertaken to allow it to pass into law. Indeed, the Government would not need any great courage to adopt the bill as its own during the final stages. The subject is to be discussed at a debate arranged by

the University of London Animal Welfare Society at Birkbeck College, Bream's Buildings, Chancery Lane, at 8 P.M. on Friday, Nov. 4. The principal speakers will be Mr. A. C. Dewbury, representing the Royal Society for the Prevention of Cruelty to Animals, and Mr. A. C. Knight, representing the Meat Traders' Federation; the chair will be taken by the president of the University society, Prof. F. T. G. Hobday, principal of the Royal Vetermary College The public will be admitted to the debate without ticket

Dr. William G. Savage delivered the Malcolm Morris Memorial Lecture (under the Chadwick Trust) on Oct. 17, the subject being "Food Poisoning." After paying a tribute to the memory of Sir Malcolm Morris, the lecturer said that food poisoning in the main is a result of the complexity of our food supply and might be classified thus: (1) the poison is inherent in the food, eg poisonous fish; (2) the poison may be an admixed poisonous substance accidentally introduced, e.g. arsenic; or (3) the poison may be of bacterial origin, by far the largest class. Earlier conceptions of food poisoning were dominated by the idea that the poisoning was from decomposed food in which poisonous chemical substances were generated by bacterial action, and this was commonly known as 'ptomaine poisoning.' This idea is, however, entirely erroneous—there is no such thing as ptomaine poisoning. Tainted food does not as a rule cause food poisoning; in nearly all cases the food is perfectly good physically. The cause is elsewhere, and is generally due to certain special bacilli gaining access to the food and having poisonous properties but do not decompose the food; it is a definite infection of the It is particularly manipulated and much handled foods that become infected, such as chopped meat, meat pies, sausages, and canned foods. The bacilli usually gain access to the food from an outside source, through lack of adequate care in preparation or storage, or by contamination through flies or vermin The prevention of food poisoning depends upon a knowledge of where the bacıllı live and how they gain access to the food, and in adequate supervision of the preparation and storage of made-up foods.

The stone implements recently discovered by Mr. J. P. T. Burchell in Co. Sligo, Ireland, will be on exhibition in the rooms of the Society of Antiquaries of London, Burlington House, Piccadilly, between the hours of 10 a.m. and 6 p.m. from Monday, Nov. 21, until Tuesday, Dec. 6, inclusive. The rooms of the Society will be closed to the public at 1 p.m. on the following dates: Nov. 23, 24, and 26, until 10 a.m. Monday, Nov. 28; Dec. 1 and 3, until 10 a.m. Monday, Dec. 5

The Huxley Memorial Lecture of the Royal Anthropological Institute for the year 1927 will be delivered by Dr. Aleš Hrdhčka, of Washington, on Nov. 1, at 8.30 p.m., at the rooms of the Royal Society, Burlington House. Dr. Hrdhčka has taken as his subject "The Neanderthal Phase of Man"—a subject which he has made peculiarly his own and upon which he may be expected on this occasion to

put forward views of no little importance for the study of early man. At the conclusion of the lecture the Huxley Memorial Medal of the Institute will be presented to Dr. Hrdlička. Tickets for the lecture may be obtained on application to the Hon. Secretary of the Royal Anthropological Institute, 52 Upper Bedford Place

MISS CATON-THOMPSON has left for Egypt, where, during the coming winter, she will continue her work of exploration in the Northern Fayum. She proposes this year to devote herself to an examination of the graves in the hope that she may be able to find material which will throw light upon the dating of the early civilisation of this area which she has discovered in her previous season's work. A very high antiquity has been attributed by some authorities to this remarkable culture. If, therefore, the investigations of this year should meet with any measure of success, the results should prove of very special importance. As the arrangements under which Miss Caton-Thompson has worked hitherto have now lapsed, the present expedition is being carried on under the direction of the Council of the Royal Anthropological Institute, which has applied to the Egyptian Department of Antiquities for a concession. The Council of the Institute invites subscriptions towards the cost of the expedition, which will amount to at least £1000. Contributions should be addressed to the Hon Treasurer, Royal Anthropological Institute, 52 Upper Bedford Place, W.C.1.

Among the recent acquisitions at the British Museum (Natural History), we notice the following:-A large collection of mammals, birds, and birds' eggs from Abyssinia; a large collection of leeches, earthworms, tapeworms, etc., and a collection of millipedes from Colombia, and two shells of the extremely rare and much prized gastropod Voluta bednalli. Only two or three examples of this species are known. A collection of European and exotic Coleoptera and of Hemiptera Heteroptera (plant bugs) bequeathed by the late Mr. G C. Champion. The major portion of the bequest consists of some 120,000 beetles from various parts of the continent of Europe, forming probably the richest European collection in Great Also a collection of 8406 Lepidoptera (butterflies and moths) presented by Mr. G T. This donation includes a large Bethune Baker. number of types and paratypes of species described by its late owner, as well as 5574 specimens of British Tortricidæ (small moths, many of them of great economic importance), comprising the entire collection of these insects formed by Mr. Richard South. About 500 seeds and fruits collected by the donor, Miss M. Chandler, in the Upper Eocene clay of Hordle, Hants, and described by her in the monograph of the Palæontographical Society. Many of these are new to science; the whole flora shows relations to that now living in the Far East, and indicates a warmer clunate. Some fine ammonites and other fossil cephalopod shells recently collected from the Gault of Dorset have been presented by Lt.-Col. R. H. Cunnington, and the Gault of Glynde, Sussex, has yielded to the careful search of Mr. C. T. A. Gaster nearly a thousand tmy ammonites belonging to about 14 species. The Lower Perman Sandstones near Exeter have from time to time yielded footprints and other tracks of extinct animals, and Mr. Clayden has added to the national collection four slabs with very unusual tracks of origin as yet unexplained

An Italian Aictic expedition by airship is being planned for next year. The Times announces that the expedition will be organised and led by General U. Nobile, who accompanied Capt R. Amundsen in his polar flight in 1926 The Italian government has offered airship N 4, which is a sister ship of the Norge. used on that occasion, and the Norwegian Aero (lub has promised the use of airship sheds at Vadso and Kıng's Bay. General Nobile intends to make his Arctic base in Spitsbergen and to explore eastward to the north of Siberia, intending no doubt to throw light on the unknown northward extension of Nicholas Land. He proposes also to make a flight to the Pole. The Soviet Government has expressed a wish to help by establishing a base with supplies at the mouth of the Yenisei River. At present a committee at Milan is considering the cost of the project. The Royal Italian Geographical Society has promised its support.

The newly formed Greenland Association of Copenhagen, which is seeking to open up this great sub-Arctic territory, learns that the University of Michigan, U.S.A., is sending a scientific expedition to this great island to study and report on the meteorological conditions prevailing there. The expedition will be under the charge of Herr Helge Bangsted, who proposes to build an Ice-station somewhere in the centre of Greenland, where the condition of the great ice-cap will be studied and general glacial researches made. Mr. Bangsted, it may be remembered, was a member of the Knud Rasmussen expedition to Greenland sometime ago.

An original suggestion has been made to Signor Mussolmi by an engineer and architect named Pio Franchi. His idea is to execute an exact model, in high relief, of the Italian peninsula from the Alps to Cape Passaro, the southernmost point of Sicily, to be placed in a miniature lake sixty metres in diameter, representing part of the Mediterranean and Adriatic Seas, with the exact imitation of every geographical detail-mountains, rivers, lakes, towns, railroads, etc. The principal rivers, such as the Po, the Tiber, and the Arno, would be represented by rivulets of running water, reproducing the exact curves. It is proposed to place this relief model in the Villa Umberto, the object being to give children and the general public a clear idea of their country. The idea has, says the Monitor, met with the Duce's approval, so that it will be shortly carried out.

THE eighteenth annual exhibition of electrical, optical, and other physical apparatus, organised by the Physical Society and the Optical Society, is to be held on Jan. 10–12, 1928, at the Imperial College of Science and Technology, South Kensington. The exhibition committee invites offers from research

laboratories and institutions, and from individual research workers, of suitable exhibits for the research and experimental section of the exhibition. Offers of exhibits in this section should be communicated immediately, and in any case not later than Nov. 16, to the secretary, Physical and Optical Societies, I Lowther Gardens, Exhibition Road, London, S.W.7.

At the annual statutory meeting of the Royal Society of Edinburgh, held on Oct 24, the following officers and members of council were elected.—President, Sir James Ewing, General Secretary, Prof. R. A. Sampson, Treasurer, Dr. J. Watt; Curator of Library and Museum, Prof. D'Arcy W. Thompson, Councillors, Prof. G. Bargei, Mr. J. Bartholomew, Prof. G. Darwin, Prof. D. Waterston, Mr. J. W. Peck, Dr. J. Ritchie, Prof. R. Stanfield, Dr. A. L. Turner, Dr. G. W. Tyrrell, Prof. J. H. Ashworth, the Hon. Lord Constable, Prof. E. Taylor Jones.

VIOLENT earthquake shocks were recorded in various parts of the United States and Canada on Oct. 24. The greatest disturbances seem to have been registered between 11 a.m. and 11.20 Mr. J. J. Shaw, of West Bromwich, records in the *Times* that his instruments registered large movements, beginning just after 4 p.m. on Oct. 24, which corresponds to 11 a.m. Eastern time, and continuing until about 5 20.

THE Report of the Progress of the Ordnance Survey for 1926-27 has been published (London Stationery Office. 9d. net) Among the achievements may be noted the completion of the "Popular Edition" of the 1-meh map of England and Wales, and the publication of fifteen sheets of the same map of Scotland, making a total of twenty-five sheets of that country. The 10-inch map of Great Britain is now complete in three sheets, the 1/M physical map of England and Wales is being improved, and a similar map of Scotland is in hand. The usual revision in the field of the large-scale maps has been carried out, but the reversion to quarter sheets of the 6-meh man has caused some delay in publication. A revised edition of the map of Roman Britain will shortly be ready. A considerable amount of archeological work has been undertaken. Lastly, it may be noted that the output of maps, exclusive of those for other departments, reached more than three-quarters of a million, and sales of maps showed a marked merease.

The long spell of wet weather in Great Britain that began in June and continued with extraordinarily few breaks up to the end of the holiday season, had a very abrupt end when a ridge of high pressure advanced from the Atlantic on the night of Oct. 2 behind an unusually fast-moving depression which had caused gales and very heavy rain in the north. A general sustained upward 'surge' of the barometer then occurred over a wide area, and this converted the 'ridge' into a large circular anticyclone in the space of twelve hours. At 7 a.m. on the morning of Oct. 3 this anticyclone lay centrally over the British Isles, and was still growing in size. It proved very persistent, and inaugurated a long spell of dry weather over the whole country. At Kew Observatory slight rain fell on

Oct 1 and 2, amounting altogether to two millimetres, but from then up to the 21st there was an unbroken succession of days with no rain or only a fraction of a millimetre. At Glasgow and Plymouth a dry spell of almost equal length has been recorded, which would have been a general experience over practically the whole of England and a large part of Scotland but for some local rain in the Midlands and the north on Oct 12. This has been the longest spell of drought at Kew this year, and unless some decided change takes place, October, normally the wettest month, may prove to be for London very much the driest in the present year

The Compton medal of the Institution of Automobile Engineers has been awarded to Mr. H. R. Ricardo for his paper entitled "Some Notes on Petrol-Engine Development."

The Cambridge University Press will shortly publish "A Short History of Western Civilisation," by Prof. A. F. Hattersley, the aim of which is to trace the origin and growth, in its essential features, of the European civilisation of to-day. The same publishers are also issuing "The Antiquity of Man in East Anglia," by J. Reid Moir, who has endeavoured to give an easily understood account of the remains discovered in Norfolk and Suffolk which, in many

cases, are of such a nature as to have implications extending far beyond the relatively small area in which they were found.

Applications are invited for the following appointments, on or before the dates mentioned :- A pathologist and curator at the Royal London Ophthalmic Hospital—The Secretary, Royal London Ophthalmic Hospital, City Road, E C I (Oct 31) A lecturer in the pharmacy department of the Sunderland Technical College—The Chief Education Officer, 15 John Street, Sunderland (Nov. 7). A farm duector at the Rothamsted Experimental Station-The Secretary, Rothamsted Experimental Station, Harpenden, Herts (Nov. 14). A chemical assistant in the laboratories of the Research Association of British Flour Millers-The Director of Research, Research Association of British Flour Millers, Old London Road, St. Albans. teacher in mechanical engineering at the Barnsley Mining and Technical College—The Principal, Mining and Technical College, Barnsley. An engineering assistant in the electrical engineer's department of Stoke-on-Trent — The City Electrical Engineer, St. George's Chambers, Kingsway, Stoke-on-Trent clinical pathologist at the Crichton Royal Mental Hospital, Dumfries—The Physician Superintendent. Crichton Royal Mental Hospital, Dumfiles

#### Our Astronomical Column.

Brilliant Meteors on Oct 17—Mr. W. F. Denning writes that "on the night of Oct. 17 three brilliant meteors were visible at the following times respectively: 21h 55m, 22h 15m and 23h 36m. The inctor of 22h 15m was a Capricornid; the other two were fine Orionids. The one which appeared at 23h 36m was a very brilliant object and observed from Yorkshire and from Erith, Kent. The meteor passed from over Cromer to east of Nottingham, and fell from a height of 86 to 52 miles. The luminous flight was about 92 miles long, and the velocity 38 miles per second. The maximum of the Orionid shower usually occurs on Oct. 20 or 21, and the appearance of several large meteors from it as early as Oct 17 mduces the supposition that the display may have been of rather unusual richness this year."

The Atmospheres of the Giant Planets —The Scientific American for October contains an article on this subject by Prof. H. N. Russell, who writes from the Lowell Observatory, Flagstaff, and utilises many of the beautiful planetary photographs obtained there by Dr. E. C. Slipher, some of which are reproduced. (A small slip should be noticed; the markings seen on Saturn in 1876 and 1903, and used for finding the time of rotation, are described as dark instead of bright.)

The radiometric observations of Coblentz and Lampland are quoted as proving that the outer regions of the atmospheres of the giant planets are at a very low temperature; but that, as there is a series of cloud layers many thousands of miles thick, these would be an effective blanket to outward radiation, and the temperatures at the surfaces of the planets may be much higher.

As is well known, the spectra of these planets show a series of strong absorption bands, which steadily increase in strength as we travel out from Jupiter

to Neptune. This suggests that a very low temperature is required for their production, the suggestion is made that, if a long tube were cooled by a surrounding jacket of liquid air and filled with various gases, a study of their spectra might give a clue to the identification of the gases producing the bands. It is noted as a possible clue that some of the oxides of introgen can be protected from decomposition only by keeping them very cold. The great variety of colours seen on the discs of Jupiter and Saturn is given as an additional proof that a large number of gaseous compounds are present.

of gaseous compounds are present.

The photographs that are reproduced were taken in light of different colours. As might be expected, those in violet light show much greater darkening at the limbs, for the same reason that the setting sun looks red. The polar regions of Saturn are especially dark. The light from the ring, when photographed in yellow light, looks about equal to that from the middle of the disc, but in violet light the ring is the brighter.

Tables for Motion in an Ellipse.—Dr Innes has published a very useful table, giving the abscissar and ordinates of a point describing an elliptical orbit under gravitation. The focus is the origin, and the major axis is the axis of x. The values are given to five places of decimals, the semi-major axis being taken as unity. They are given at intervals of one degree of M, the mean anomaly, and for intervals of 0.01 in the eccentricity, extending from 0.00 to 1.00. The tables are mainly intended for work with rectangular co-ordinates, but they are also very useful for those who prefer polar co-ordinates, since  $\tan v = Y/X$  and r = X sec v or Y cosec v. Similar tables have appeared before, but not on quite such an extended scale. They are useful both in the computation of ephemerides and of perturbations. They form an appendix to Umion Observ. Circular, No. 71.

## Research Items.

CLIMATIC CONTROL OF WHEAT AND WOOL IN Australia -Mr. Henry Barkley, the Senior Research Meteorologist of the Commonwealth Weather Bureau, has published preliminary results of the control exercised by rainfall during critical periods on production in Australia. The first paper (Wheat and Grain Review, Aug. 6) shows that after allowing for the gradual improvement due to improved methods, 90 per cent. of the variations in the Victorian wheat harvest depend on fluctuations of the rainfall in August and September, thus enabling a very good forecast to be made two months ahead. The relationship is not linear, but the wheat yield is roughly proportional to the logarithm of the rainfall. In other parts of Australia the critical periods vary from June to August. Another interesting result which the author obtains is that there is very fair agreement between the spring wheat yields of Victoria and the contemporary autumn yields of Canada and, until 1916, Russia This is attributed to a general control of the climates of all three countries by solar variations, which cause a cyclic change of roughly three years. Mr. Barkley's second paper (Pastoral Review, August) deals with the control of the wool yield in November by rainfall as early as January and February. The relationship is again very close; the weight of the wool clip shows a progressive increase as the rainfall of the two months together rises from 1 to 4½ inches; the latter is the optimum value and heavier rain causes a slight falling off. It is not yet clear, however, whether the increase of weight represents a real gam of that amount, or whether it is partly due to an increase of greasy matter, and further data are required to settle this and some other doubtful points. It is to be hoped that Mr. Barkley will be able to continue these valuable researches, which have a direct bearing on Australian production.

CANADIAN SALMON.—Few observations have been made on the biology of the Atlantic salmon (Salmo salar) from Canadian waters, and a recent publication by W. L. Calderwood on the salmon of the River Grand Cascapedia in the Quebec Province is welcome (Proc. Roy. Soc. Edinburgh, vol. 47, pt. 2, No. 10, 1927). The number of scales examined was unfortunately low, but they appear to furnish information of considerable interest. The smolt ages were remarkably high, the three and four-year-old smolts forming 58.8 and 34.1 per cent. of the whole respectively. There were no one-year-old smolts and two were five years old. In this respect they resemble those from certain northern rivers in Norway, although they do not agree with results from the River Moisie in Čanada, which hes north of the Grand Cascapedia, where two-year-old smolts were the most common. There were no grilse, neither were there any small spring fish represented in the samples. In fact only eleven fish returned after two winters in the sea, while the majority did so after three winters. though the fish do not come into the fresh water early because the river is not open, no summer feeding appears on their scales. The fish of the predominant three-winter group averaged 23.6 lb. and the average length was 38.3 in. Of the 182 fish, 62 had spawned previously—48 once and 14 twice.

Tanning Materials of Australia.—The Council for Scientific and Industrial Research of Australia has just published a survey of the tanning materials of the commonwealth (Bulletin No. 32, by D. Coghill).

The survey was designed to explore the possible commercial resources of Australia in vegetable tanning materials. With this end in view, all the barks, woods, twigs, leaves, and fruit from which tannin could be extracted have been examined, and their possible utilisation discussed. While no new sources of importance have been discovered, the availability and quantity of the tannins previously known have been thoroughly re-examined, with the view of establishing a flourishing tannin extract industry in Australia Western Australia is rich in natural sources of tannins, while the eastern provinces provide a fertile and broad ground for the cultivation of those species which give a good yield of tan bark, and grow quickly. The proposition is a praiseworthy one. New sources of tannins are urgently needed. Already Australia has to import some of her tan extracts, and during the last few decades there hasbeen an increasing dependence of the older countries on tan stuffs imported from new and less-developed regions, a condition of things accentuated recently by the ravages of the chestnut blight, which is seriously reducing the supplies of tanning materials obtained from that tree.

STIMULATION OF PLANT ACTIVITY. - Many chemical substances, apart from those ordinarily recognised as fertilising elements or yielding energy to plants by oxidation, are known to increase in several ways the rate of growth. F. E. Denny, of the Boyce Thomson Institute for Plant Research, discusses some such effects (Proc. U.S. Acad. Sciences, vol. 13, July 1927). The yellowing of commorcially mature but still green lomons and oranges may be very much accelerated by exposure to minute quantities of ethylene gas -- one part or less in 10,000 parts of air. A study of the respiration of lemons so exposed showed that the physiological activities of the fruit were greatly increased, the rate of production of carbon dioxide being doubled or trebled in 48 hours. So far, the mechanism of this respiratory increase is unknown. Furthermore, the stumulating effects of ethylene are not confined to Citrus truits, for Rosa found that the rest period of dormant buds of potato could be shortened by suitable treatment with that gas. Denny now finds that several chemical agents will break the rest period of plants; e.g. ethylene chlorhydrine, ethylene chloride, various thiocyanate solutions, acetaldehyde. The chemicals that were found to cause stimulation varied greatly in character, so that no evident relation could be established between the type of chemical used and the result obtained. In most cases it did not seem possible that the substance was used by the plant directly as food, and in no case could it have supplied. sufficient energy to account for the resulting increased activity. Now Carrol and Baker found that the substance in embryonic tissue which markedly stimulated multiplication of isolated cells was the product of the partial hydrolysis of a protein. The present author suggests that possibly the slight miury produced by those chemical stimulants may cause a slight and partial decomposition of constituents of the tissues, resulting in the release of growth promoting substances which start up renewed cells division and bud growth.

ORIGIN OF MUTATIONS—Some experiments by Dr. A. M. Banta and Mr. T. R. Wood of the Station for Experimental Evolution at Cold Spring Harbour are described in a recent bulletin of Science News Service of Washington. Dr. Banta has been investi-

gating the genetics of Cladocera for many years, growing great numbers of them in water bottles under controlled conditions. One mutation which appeared recently failed to thrive under the ordinary conditions, but flourished and multiplied when kept in water at a higher temperature. It is suggested that the organisms inhabiting hot springs have originated in a similar way, through mutations adapted to high temperature conditions occurring near a hot spring where their descendants could reach the environment necessary for their prosperity.

NORTHERN CYCLOSTOMES AND ELASMOBRANCHS -Recent additions to the fishes in "Die Tierwelt der Nord- und Ostsee" (Leipzig: Akademische Verlagsgesellschaft. 1927) are the Cyclostomes (Cyclostome, by W Schnackenbeck, Teil XII. d), and the Elasmobranchs (Elasmobranchu, by E Ehrenbaum, Teil XII. e). The cyclostomes in this area consist of three genera, each represented by one species, namely, Petromyzon marinus, the sea lamprey, Lampetra fluviatilis, the liver lamprey; and Myxine glutinosa, the hag-fish. The true fresh-water lamprey, Lampetra planeri, although mentioned in this work, does not strictly come within its limits Dr Ehrenbaum gives a good account of the elasmobranchs. monstrosa is the only representative of the Holocephali in north European waters, and most of this section is taken up with the description of the Selachii (sharks) and the Blatoidei (skates and rays). The low salinity of the Baltic bars the presence of elasmobranchs except as occasional visitors, therefore nearly all the species recorded are from the North Sea area and several of these are very rare, such as the electric and eagle rays and some of the sharks On the other hand, certain rays, such as Raia clavata in the North Sea, the Skager Rack, and Cattegat, and Raia batis with a wider range, have here their maximum distribution, whilst the cosmopolitan Acanthias vulgaris is the commonest doglish and is to be seen in swarms in the North Atlantic Sharks and rays feed upon Sharks and rays feed upon almo t all the groups in the animal kingdom—fishes of all sorts, molluses, crustacea, echinoderms, annelids, and even sea-anemones and ctenophores, Selache maxima, the basking shark, being entirely a plankton feeder, eating small crustacea and even diatoms. Good notes are given on the feeding and breeding habits of all known forms.

Japanese Pliocene Mollusca—The molluscan fauna of the lower part of the Kakegawa (Lower Phocene) Series in the province of Tôtôrm forms the subject of a monograph by Jirô Makiyama (Mem. Coll Sci. Kyoto Imp. Univ., ser. B, vol. 3). The beds in question, Dainitian, occur between Hutamata and Minamiyama on the Tôkaidô, or East Sea Road, and seem referable to the Plaisancian. The fauna contains 171 species of which 46-8 per cent. are known as living Detailed descriptions of these, including many new species, are given and accompanied by six excellent plates.

PEAT AS A SOURCE OF WAX—The curious metabolism of peat plants, which releases large quantities of fatty substances, and impresses very characteristic structural features on the plant form, was investigated a few years ago by Priestley and Hinchliff (see The Naturalist. 1922, p. 263, and 1924, p. 201). These fatty, by-products are now being turned to commercial account. In the current issue of the Bulletin of the Imperial Institute (vol. 25, No. 3) an account is given of some experiments which have been carried on there on the extraction of wax from some samples of peat from Chatham Islands. The work follows on similar researches already carried out in Germany

Hot extractions made in a Soxhlet apparatus with chloroform as a solvent gave the remarkably high yield of 25 per cent. of crude wax, the yield in the case of most peats so far tested being from 6 to 8 per cent. The cost of chloroform, however, prohibits the use of this method as a commercial venture. Other experiments showed that benzene or mixtures of benzene and alcohol were almost as efficient for extracting wax from the peat, besides showing considerable advantage in regard to cost Preliminary trials indicated that kerosene might possibly be used, but its high boiling point made the subsequent separation of the wax difficult. The crude wax had a dark colour, a melting point from  $70^\circ$  to  $74^\circ$  C, and could not readily be It is estimated that a market could be bleached. found for 500-2000 tons of the wax per annum for use in boot polish and related industries. An analysis of the peat remaining after extraction of the wax showed that the residue would form a useful fuel

SMALL ELECTRIC FURNACES FOR THE LABORATORY.—The Chemiker-Zeitung of Sept. 28 contains a description of a new type of small electric furnace, with which a crucible can be heated in one hour to a temperature of about 860° C. The furnace is most easily adapted to a tension of 110 volts, and if the current does not exceed 2.2 to 2.4 amperes the heating coils will last for several thousand hours. The furnaces are made by the firm Hugo Helberger, of Munich, and are provided with specially adapted regulating resistances, by means of which it is easily possible to control the temperature.

The Weathering of Textile Fibres — The Chemiker-Zeitung for Oct 8 contains an account by Dr. H. Sommer of experiments on the weathering of textile fibres, carried out on the roof of the observatory at Neubabelsberg, near Potsdam. The complete record of the investigation will be found in the Leipz. Monatschrift fur Textilindustrie. It has been found that the weathering is chiefly a surface effect produced mainly by ultra-violet rays and is helped, particularly in the case of wool, by the presence of moisture. Of the different materials examined, silk proved to be the least and wool the most resistant to the disintegrating action of sunshine. The sunshine-hours required to produce comparable effects were as follows: silk, below 200; jute, 400, artificial silk, 900; cotton, 940; flax, 990, hemp, 1100, raw wool, 1120; chromed wool, about 1900; but differences in thickness were not taken into account.

The Carbon Arc—The issue of the Physikalische Zeitschrift for Sept. I contains a paper by Drs R. Seeliger and H. Schmick, of the University of Greifswald, on the mechanism of the carbon arc. By the use of an arc enclosed in a vessel, they have been able to study the effects of reducing the air pressure from atmospheric to 2 or 3 cm. of mercury, on the positive crater and the light it emits, and on the volt-ampere characteristic of the arc. They find that in air and in nitrogen, the area of the crater increases, and the current per unit area of the crater therefore decreases as the pressure decreases. The increase of area of the crater is accompanied by a decrease of its temperature and a decrease of the voltage between the carbons. If the decrease of pressure is slow, at 1 or 2 cm. of mercury, the pressure rises from below 40 to 50 or 60 volts, and at about 0 5 cm. of mercury falls suddenly to 32 volts, at which it remains steady, the crater being much reduced in area. No theory of the arc has been propounded which will account for the facts observed.

## The New School of Biochemistry at Oxford.

THOUGH the study of chemical physiology in Oxford began some three hundred years ago, it is only within the last few years that this subject has been recognised as a separate school of science. It then became clear that the importance of the study of the chemistry of living things together with the rapid extension of knowledge in this field made it imperative that recognition should be given to biochemistry by the foundation of a readership or chair. The University was fortunate in the generosity of Mr. Whitley, of Trinity College, who made possible the foundation of a chair, thenceforward known as the Whitley Chair of Biochemistry. To this chair was elected, in 1920, Dr. Benjamin Moore, who may be regarded not only as the first to hold the chair of

were opened by the Rt Hon. Viscount Cave, Chancellor of the University, on Oct 21, biochemistry ceases to be taught in the premises of the Department of Physiology, and this Department therefore gains valuable extra accommodation. It has, however, been an important feature of the development to keep the Departments of Physiology and Biochemistry in intimate connexion with one another. In order to accomplish this, the new building is L shaped and forms with the old Department of Physiology part of a quadrangle. There has also been incorporated in the scheme of development a conjoint library and a conjoint large lecture room. The buildings are turther connected by passages upon two floors, a great convenience for students.

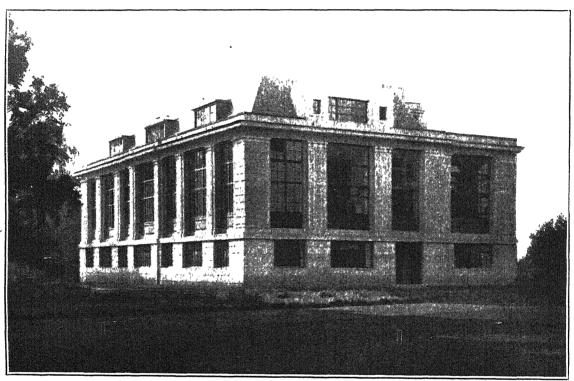


FIG 1 .- School of Biochemistry University of Oxford.

biochemistry at Oxford, but also as among the pioneers of biochemistry in Great Britain. Unfortunately for Oxford, Moore did not live long to enjoy his new The present holder of the chair, Dr. Rudolph A. Peters, was elected towards the beginning of 1923. Shortly after he came to Oxford, the University received from the Rockefeller Foundation an offer of £75,000 towards the erection of a new Department of Biochemistry. £55,000 of this was to be devoted to the building and its equipment, and the remaining £20,000 towards maintenance. This offer was accompanied by the condition that the University should guarantee to contribute the sum of £25,000 or its equivalent in annual income towards the general maintenance of the new Department. This munificent gift was gratefully accepted by the University Not only did it provide for a proper development of biochemistry, but also it solved the acute problem of providing additional accommodation for the Department of Physiology, a need that had been long delayed.

By the possession of these new buildings, which

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The building has been designed by Mr. H. Redforn and is built in a classical order, which was made necessary by the need for large windows and therefore narrow wall spaces between them. It consists of three floors and a mezzanine floor. Upon the ground floor are found, besides the usual offices, the conjoint lecture theatre capable of holding some two hundred persons, cold storage, a dark room for photographic work, and one for physical work. There are also a workshop and preparation room, and a small room for nutrition work upon rats The first floor, which may be styled the teaching floor, is connected by through passage with the Department of Physiology. It consists of two large class rooms built side by side and capable of accommodating about one hundred students at a time. They can be used either as one room or two. In addition to the class rooms there are students' balance room, a polarimeter room, and a demonstration lecture theatre. The upper or second floor is reached through a mezzanine floor made possible by the height of the class rooms. Upon this floor is to be found a rest room, a room for constant temperature work, a research room with roof lighting, and the entrance to the indoor animal house. The second floor is entirely devoted to investigation. Besides a professor's research suite and other research rooms, there is also a sterilising room, a small bath room, an operating suite, an outdoor laboratory, and an aquarium room. This floor opens direct to a flat roof

With regard to the fittings, gas, water, and electric power have been brought into all rooms, and a trough system has been adopted for the drainage of water. Using this in conjunction with movable tables and cupboards designed upon a unit system, it will be possible for each research worker to arrange the benches to suit the particular investigation upon which he is engaged.

Subject to any unforeseen development, the present

building should satisfy in the main the needs of biochemistry in the University for the present. Smaller wants are not yet, however, adequately met. There is, for example, the question of the research library, for which separate endowment is required. The modest sum of £2000–£3000 would go far to provide what is required in this direction. The most serious want of all, however, is believed to be that of providing studentships to enable the better men to stay behind for a period of one to two years to obtain training in research work, and so obtain the fullest possible use of the scientific opportunities of the University. This is a need which the Department of Biochemistry shales with other scientific departments, and until it is properly met there is no doubt that Great Britain will not make the best possible use of the brains of the younger generation at the University.

## The University of Birmingham.

NEW BIOLOGICAL BUILDINGS.

WITH the progress of the biological sciences, both methods and needs have changed. The laboratories and apparatus of a generation ago are no longer adequate even for teaching purposes, still less for research. At Birmingham the three cognate Departments of Botany, Zoology, Brewing and Biochemistry of Fermentation have long been inadequately housed in the older part of the University in Edmund Street. This session, however, they have moved to their new quarters at Edgbaston. The new biological block was formally opened on Oct. 20 by the Prime Minister, Mr. Stanley Baldwin.

The buildings, the site and general character of which form part of the original design of Sir Aston Webb, face University Road, being situated between the Chemical Department and the Harding Library. The total cost of buildings and equipment is upwards of £120,000, towards which Sir William Waters Butler, Bart, has generously contributed £40,000,

and an anonymous donor £5000.

Zoology occupies the ground floor of the new block, brewing and biochemistry of fermentation the greater part of the first floor, and botany the second floor, with certain rooms also on the first floor. A large lecture theatre, shared by all three departments, each of which also has its own lecture room, forms a third floor.

One important development is the recognition of the principle of departmental libraries. Each of the three departments in the new block has its own separate library, in which will be housed nearly all the periodicals and books dealing with the three subjects respectively. These departmental libraries will be under the general supervision of the University Librarian and the Library Committee.

The three departments have already started work in the new buildings, although the internal equipment and furnishing is not yet complete. The following

accounts deal with the new departments.

#### ZOOLOGY.

The new Zoological Department, which forms the ground floor of the biological block, has been constructed on a spacious scale. There are three teaching laboratories, for elementary, for advanced, and for post-graduate honours students respectively. The laboratories have ample accommodation, good lighting, both daylight and artificial illumination, and modern fittings. The Department possesses a small lecture theatre for advanced teaching, while the zoologists, botanists and biochemists between them share a large theatre. This lecture theatre accom-

modates the large elementary class, the greater proportion of whom are medical students.

Original research is as much the raison d'être of a university scientific department as is teaching. For the purposes of research the new department is admirably equipped. The apparatus includes not only the microscopes and microtomes of the classical zoological laboratory, but also the numerous and often elaborate apparatus used in the newer experimental developments of the science. The members of the staff have each a private room fitted out as a laboratory. There is a research laboratory for other original investigators working in the department, with a special room for entomologists, dark rooms, an animal room, a tank room, etc.

The Department has a distinguished past record. Prof. T. W. Bridge, one of the original professors at Mason College, Birmingham, carried out much valuable research work on fishes. His successor, the late Prof. F. W. Gamble, is known to zoologists all over the world for his researches on the colour changes in crustaceans and for his study of the remarkable composite organism Convoluta, a planarian worm with symbiotic algæ. The late Prof. Leonard Doncaster was a member of the staff when he did his epoch-making work on sex-inheritance in the moth Abraxas grossulariata. Mr. H. G. Newth, the present senior lecturer, is an embryologist who has made a number of important original investigations. Incidentally, a large share in the design of the laboratories and fittings falls to his credit. The present head of the Department is Prof. H. Munro Fox.

## Brewing and Biochemistry.

The British School of Malting and Brewing and Department of Biochemistry of Fermentation was founded at an earlier date than the incorporation of the University of Birmingham. Accordingly, at first, it was a department of Mason University College. The School was formally declared open by Mr. H. Cosmo O. Bonsor, on Jan. 18, 1900. The late Prof. Adrian Brown had been appointed, and held the position until his death in 1919, the School being maintained during that interval by contributions from the brewing industry. After the death of Prof. Brown, a further appeal was made to the brewing industry, with the result that a full endowment was provided for the chair, to which the name of Adrian Brown is attached.

The Department consists of a series of sixteen rooms running from east to west. There is a spacious general laboratory, a well-appointed microscope room,

and a research laboratory. The professor and the lecturer have each a private room and a laboratory assigned to them, and there is a special laboratory for analysis, and incubator room and dark rooms for

photography and polarimetric work.

One of the objects of the School is to advance research in the many fields open to investigation in connexion with the fermentation industries, and the professor possesses wide powers with regard to aiding the investigations of competent workers by finding accommodation in his laboratories, and in other ways Applications concerning such questions should be made to the professor direct

Prof Adrian Brown's research work is well known. It dealt with studies on micro-organisms—bacteria and yeasts—and the products of their action on different substances. He studied specially alcoholic fermentation, and made many notable contributions to the chemistry of enzymes. The high reputation of the Department for training and research built up by the late Prof Adrian Brown has been well maintained during the eight years which have clapsed

since his death.

#### BOTANY.

The new Botanical Department, comprising some thirty-three rooms, occupies the second floor of the new block, as well as the eastern portion of the first floor. On the first floor are sterilising and incubating rooms for mycological work, staff and preparation rooms, and the herbarium. The latter contains a number of important collections, being particularly rich in cryptogams.

The eastern end of the second or mam floor is designed chiefly (though not exclusively) for teaching purposes, and the western end for research. Between these two parts, conveniently placed for both, are the departmental library, museum, store rooms, etc. So far as possible, laboratories and staff and other rooms in which microscope work is carried on, have been

arranged on the north side of the building

Special provision has been made for the study of plant physiology. The physiological laboratory is a large, well-lighted room at the extreme eastern end of the department. It extends across the entire width of the building, being provided with north and south windows as well as three large roof-lights. Adjacent to this laboratory are a small chemical laboratory and a physiological dark room. For experiments in which open air is necessary, a working bench- of concrete and lead has been erected on the roof. This bench, like the ordinary laboratory benches, is provided with water, gas, and electric current, and communicates with the physiological laboratory below.

In addition to the building and its fittings, a considerable sum of money has been set aside for apparatus. It may therefore be claimed that the new Botanical Department is well equipped and thoroughly up-to-date. In particular, the facilities

for research have been vastly improved.

### THE PRIME MINISTER'S TRIBUTE.

The new buildings were formally opened by the Prime Minister at a special congregation in which the Chancellor (Viscount Cecil of Chelwood) conferred upon Mr. Baldwin the honorary degree of LL.D. The choice of Mr. Baldwin was singularly appropriate, for not only is he a Midlander, but he was also at one time a student at Mason College, and the University of Birmingham can thus claim that it is the only provincial university which has a Prime Minister on its register of students. The function was in every way a success, and the Prime Minister, in proposing the toast of "The University" at the luncheon which

followed, made an eloquent and impressive speech. He thought that few developments in Great Britain were more full of hope than the development of the modern universities, a development of modern times which would be looked on by the historians of the future as the genuine renaissance of the nineteenth; and twentieth centuries—a renaissance as genuine and as pregnant in its hopes for the future as the renaissance of the fifteenth century. "You have to go back about a century to see the first roots of this movement. At that time Oxford and Cambridge were more or less monastic institutions in which learning was preserved, with some skill, in cold About that time you begin to see the rise storage of the literary and philosophical societies, in cities like Manchester and Birmingham pre-emmently. They were societies on which (as with all good movements) much scorn was poured in their own day. Quarterly and Edinburgh Reviews, which stood then for the highest forms of culture, used to denounce them on the ground that they encouraged the vice which has always been a favourite vice in Birmingham -they complained that they showed an exclusive fondness for speculation on the constitution of matter -no uninteresting of unimportant subject

It was not until the last half of the nineteenth century that the university movement began to gather strength, and in Birmingham it was associated with the wonderful activity of Joseph Chamberlain and his fellow-workers, who showed what enlightened municipal government could do. When the University of Birmingham obtained its charter, mainly through the energy of Joseph Chamberlain, the magnetic personality of that statesman secured the necessary financial support. But he passed away, and, not long after, the War came; and the University went

through difficult times.

Financial help was needed. Recent Governments had done what they could, the City of Biriningham gave £15,000 a year, and the surrounding district about £4000. Vast fortunes are not so common in the Midlands as in some other parts of the country, but that did not make it any more difficult for co-operative effort to raise money. "We are probably standing at the beginning of one of the periods of mereasing knowledge which will mark more than ever that renaissance of which I spoke. The transformation of the world is proceeding apace; the civilisation of the west is overflowing into the east, and the dead east is giving itself up from the sandhills of the desert; and the human panorama, more vivid and more extended than ever, is rolling itself out before our eyes m a way which would have filled our parents with amazement. So in science the problems of power and space, of the atom and the electron, are being attacked and invaded with more vigour and more success than at any time in the past. This work is being done by the co-operative effort of mon m a thousand colleges, such as this, all over the world. We cannot live on the sacrifices of those who have gone before. A double duty lies before us of maintainmg the work which they began, and pushing forward mto realms of which they had no conception . . . I believe that in time the people of this country will learn to realise that the teachers in these universities are the helpers and servants and the friends of humanity. And when once that essential truth has been grasped, there will be no doubt then that all the help that you need in material matters will be forthcoming."

In the afternoon the Prime Minister went to Chancellor's Hall to open the new wing of the hall of residence for men students (built through the generosity of Sir Charles Hyde), where he insisted on the value of corporate life in a university education.

## The Imperial Agricultural Research Conference.

A NUMBER of valuable reports and memoranda have been drawn up and circulated to delegates of the Impenial Agricultural Research Conference for their information and consideration. We print below some notes on points raised in these memoranda.

#### AGRICULTURAL OFFICERS OVERSEAS.

The recruitment in Great Britam for the agricultural services overseas has always been a matter of difficulty. Appointments were formerly few and irregular, and no arrangements were made to prepare men for them, with the result that, for many years, these services were more or less dependent on the flotsam and jetsam of English schools, that is, those who had not made good in Great Britam. Recruitment began to improve with the present century, in the establishment by Mr. Chamberlam of the West Indian service, and by Lord Curzon of the much larger one in India. Latterly, first India and then Egypt have closed their doors to the purely agricultural candidates, although they still appear to require scientific 'experts' in commexion with agriculture

The finding of suitable men for the Colonial service was rapidly becoming an impossible task, when the Empire Cotton Growing Corporation started its career, with the creation of a number of attractive studentships in Great Britain, with the idea of providing a sort of pool of specially trained men, from which candidates could be drawn, when needed, for pushing the growth of cotton in British dependencies. When appointed, these men were attached to the local agricultural departments The Colonial Office followed suit, and similar scholarships have been given for several years A leaflet has now been placed in the hands of the delegates of the Imperial Agricultural Research Conference advertising the creation, among others, of sixteen to eighteen post-graduate scholarships "annually, at any rate till 1933 inclusive," by the Colonial Office, and twelve studentships by the Empire Cotton Growing Corporation for the current year. The difficulty in recruitment may now be regarded as solved, in that a career is opened up for any promising student who qualifies himself in any branch of science connected with agriculture

Among the questions which have been discussed at the Conference is that of the position of scientific officers in agricultural departments and their relation to the administrative staff. Two memoranda on this subject have been submitted from Tanganyika. It is pointed out that the agricultural departments in the older tropical colonies have usually evolved from botanic gardens, to the staffs of which have been added a chemist, an entomologist, a mycologist, and m some cases a geneticist and an agricultural economist. The chemist frequently has his attention diverted from agricultural matters by demands for his services as an analyst or toxicologist, and the biological officers can rarely give adequate time to research owing to the amount of advisory work which they are expected to undertake. It is urged that the primary work of a technical officer should be that of an observer and investigator, and that his opportunities for travelling should be increased, to enable him to keep in close touch with the executive agricultural officers in the various districts, and the problems actually arising in the field. These officers, and the owners of plantations and farms who are willing to do so, should be invited to make observations on definite lines laid down by him, and thus increase the thoroughness of his investigations.

To enable such a policy to be carried out, it would

be necessary to supply the technical officers with assistants who could carry on work at headquarters while they were travelling, and also to prepare technical memoranda for use in advisory work by executive officers. A memorandum from New Zealand on the same subject indicates that the adoption of such a policy in that Dominion has proved very valuable.

# Information Bureaux on Indian and Colonial Agriculture.

The English public is not much interested in what goes on in India, unless perchance some Rajah visits England or there is a recrudescence of Hindu-Mohammedan religious nots The main employment of the people, agriculture, is scarcely ever referred to in the daily Press, and, indeed, it would be looked upon as a very dull and uninteresting subject. But it is not really so, if properly presented, and it must be confessed that writers on scientific subjects are sometimes not very lucid. This point of view is stressed by the chief agricultural officer in India in introducing the report which he has prepared for the Conference. Starting at home, he asks for a publicity officer for the Indian Agricultural Department, to popularise the work being done for all classes in the country. He goes a good deal further, and pleads for a closer haison between all parts of the Empire for the same purpose; India and the tropical colonies on one hand, and the torrid zone and temperate regions on the other In short, he suggests the establishment of a publicity bureau in London, to act as a popular clearing house of the results of agricultural research within the Empire a very different thing, of course, from the publicity section of the Empire Marketing Board The natives of most of our African Colonies grow crops similar to those in India, and largely under like conditions of climate. The hundred folio pages of this report on the present position of agricultural research in India, prepared by the heads of the various sections, on crops and their treatment, agricultural practices, cattle and all veterinary matters, should prove extremely useful to the officers engaged in trying to improve the undeveloped agriculture of our African Colonies

One of the greatest difficulties in the study of agriculture in the British dependencies overseas lies in the matter of literature. The whole range of crops in the warmer parts are different from those in Great Britain, and text-books, except on certain individual crops, are practically non-existent. The literature, therefore, consists of journals and pamphlets in London, it is often a matter of considerable difficulty to locate a particular pamphlet or report, although there are important collections in various places. The Colonial and India Offices both contain a considerable number of journals and pamphlets on agricultural subjects, but these appear to be primarily intended as official records, and are not arranged for the convenience of the occasional visitor. Imperial Institute and Kew Gardens have also accumulated a large amount of material, and this is admirably arranged for study; while the Bureaux of Entomology and Mycology will have all the information required in their respective subjects.

There are also scattered collections of less importance, and the London agencies of different countries are generally willing to supply copies of such pamphlets as they have for distribution. But there is a rather urgent need for strengthening one of these centres, or creating a new one, where the student of any

crop or practice of country may, without undue labour, find all that he wants. This subject is presumably being explored by the Colonial Office, and if the publicity bureau for India advocated above is established, this bureau will in the natural course of events be located where such a library is formed. Attention to this subject has been directed by the circulation of a leaflet describing the Science Library in South Kensington, where some quarter of a million 'references' have been got together on 'Agriculture, Economic Botany, and Forestry.'

The difficulties experienced in the collection of information as to the agricultural research going on in the different parts of the overseas Empire had to be faced by the Organising Committee of the Imperial Agricultural Research Conference The Dominions, including India, are large enough to employ a numerous and well-organised staff, and it is never a difficult matter to obtain excellent summaries of progress being made year by year. But this is not the case with the colonies, varying as they do from countries the size of France to a few minute and povertystricken oceanic islands; and it was a happy inspiration which led the Marketing Board, with the help of the Colonial Office, to circularise the various British colonies in the tropics, asking them to prepare and forward by a certain date summanes of the present position of agricultural research in them and the most pressing needs for its increase in their territorities One can imagine the interest which this circular must have caused in some of them, the ready response, and the incentive to make as brave a show as possible for submission to the collective authority of the Imperial

A summary of these reports has been prepared by the Organising Committee in handy form and printed under the title "Agricultural Research in the Overseas Empire": and a copy has been placed before each member of the Conterence Canada, Australia, New Zealand, the Union of South Africa, and the Irish Free State lead off with some 56 pages; and, with the exception of a couple of pages on Cyprus and Palestine, the rest of the 120 pages are generously devoted to tropical colonies, concluding with a note on the activities of the Empire Cotton Growing Corporation in various parts of the Empire. This pamphlet should be a veritable godsend to the student of British tropical agriculture, a subject hitherto overshadowed by the often excellent literature so freely dispensed by Java, Cuba, Porto Rico, Hawan, and the Philip-

As a kind of addendum to the summary of reports referred to above, a series of extracts have been issued in folio form, typed and bound, each dealing with a separate aspect of agricultural research in the tropics (it is obvious that it would be impossible for members of the Conference to go through the originals in the short time at their disposal in Great Britain). One of these "Memoranda" deals, for example, with "Crops and Plant Breeding," and includes extracts of special interest at the present time Such are: Breeding as applied to long-term crops, such as cacao, coffee, palms, tea and rubber, which occupy the ground for many years; shifting cultivation and its replacement—a system under which isolated areas of bush or forest are felled and burnt, and for a year or two food crops are grown, after which the land is allowed to become jungle again; the effect of grass and wild plants or cover crops on long-term plants; the problems requiring investigation in West African cacao, which is grown as a forest by the natives over large areas, without any attention to ordinary agricultural practice; the problems connected with Burma rice, the main source of this cereal food in the

British Isles, the effect of soil and climate on the quality of Nyasaland tobacco, from which country the bulk of our "Empire tobacco" comes; the efforts being now made to evolve new kinds of banana on account of the spread of the 'Panama disease' (the cultivated bananas do not usually form seed and are always reproduced for crop purposes by suckers, on the same principle as the sugar cane and our potatoes); while the concluding third of this memorandum of 47 pages refers exclusively to various problems which are met with in the Empire cane sugar industry, now severely threatened by the fiscal support given in almost all foreign countries in the tropics to their own sugar factories. Various other crops are merely mentioned at the end of the memorandum, including sisal hemp, coconuts, oil palms, and so on; and to this list is added the question of industrial alcohol, now of special importance because the production of petrol in the British Empire is so very small.

# INVESTIGATIONS AIDED BY THE MINISTRY OF AGRICULTURE.

The Ministry of Agriculture has issued for the use of the Conference two valuable publications describing the research work in agricultural science conducted at institutions in receipt of grants from the Ministry. The investigations deal with practically every important branch of agricultural science, and although conducted at many different centres, show little or no evidence either of overlapping or of lack of co-ordination. Only a few items can be selected for comment.

The question of the necessity for change of seed m potatoes is under investigation. The practice of employing seed produced under more rigorous climatic conditions is almost invariably adopted in England, and is supposed to prevent 'physiological degeneration', however, no evidence of the superiority of yield of Scotch seed over home-grown seed has yet been obtained in careful tests over several consecutive years, provided the crop be kept free. of virus disease. Although the yields of crops are more effected by season than by any other factors, a dull summer, such as the past one, is not necessarily associated with a low yield, as would at first sight be expected. In studies of barley one reason for this has been elucidated. In dull light the leaf surface is larger but less active in rate of food production than in bright light, so that the plant maintains a fair level of activity over widely variable weather conditions. Methods of statistical inquiry have been developed to deal with the data obtained from the field experiments, and their applications to results from the long-time Rothamsted experiments have brought to light previously obscure factors influencing the yield, thus enabling direct experimental tests to be undertaken. Besides climatic factors, variations m the soil conditions, even within a small area, affect the yield; the so-called 'even' crop of the farmer, if harvested and weighed in small plots, is in reality very uneven. Soil heterogeneity includes variations in physical, chemical, and biological characteristics. The latter two can only be shown at present by laboratory examination of numerous samples from the area in question, but the former is susceptible to rapid demonstration by measurements with a dynamometer of the soil resistance to a cultivation implement.

In the realm of animal husbandry, the famous permanent pastures of British agriculture have come under critical examination. The presence of wild white clover has been regarded as the essential characteristic of a good fatting pasture, and the earlier work was largely devoted to the encouragement.

of leguminous plants by phosphatic manures, and basis slag in particular, with striking results wards it was shown that the effects were only observed to their full extent on originally poor grass land and under fairly high rainfall Recently, the necessity for clover as an appreciable constituent of the herbage has been questioned. The work originated in Germany and has been actively taken up in Great Britain. It is claimed that by frequent applications of quick-acting artifical nitrogenous fertilisers, and by close stocking, a constant supply of young grass herbage is secured, which in both feeding value and amount is much greater than can be obtained by the older methods, thus enabling more head of stock per acre to be kept Investigation is being made of certain technical difficulties that may arise, such as the effect of periods of drought, the prevention of rankness in the herbage due to the animal excreta, and the possibility of the soil becoming sticky or poached in wet periods by the treading of the animals

A closely allied line of investigation is the examination of the inineral content of pastures. It has been found, especially in certain overseas regions, that serious diseases among stock are associated with a deficiency in the pasture of some essential element, e g. rodine, normally present only in minute amounts. The study of these deficiency diseases, and the methods of remedying them, either by manuring the grazing area or by direct supply in supplementary rations of the missing ingredients, has necessitated the co-operative investigation of pathologists, chemists, and agronomists. This illustration of team-work among different investigators—and different institutions—is only one of many others to be found in the researches conducted with the financial assistance of the Ministry of Agriculture.

#### EMPIRE SOIL PROBLEMS

Memorandum 8, issued by the Organising Committee of the Conference, contains the technical , papers relating to soils and manures, which are up for discussion. Almost the whole field of pedological work is touched upon, though very naturally problems relating to tropical soils form a large proportion of The Parliamentary Under-Secretary for the Colonies points out our ignorance with regard to tropical soils and the important chemical and physical problems arising in connexion with irrigation and soil deterioration. The extensive and intensive methods of carrying out a soil survey are dealt with by Sir John Russell, who emphasises the need for standardisation of methods and for more general agreement as to the determinations which shall be carried out.

Practically all the Dominions and Colonies represented submit accounts of the work being carried out by them and the special difficulties and problems with which they are faced From West Africa, as a result of a previous conference between neighbouring colonies, comes the request for the establishment of a Bureau of Soil Science the duties of which shall be the collection and collating of the results of soil investigations, the publication of approved methods of soil classification and analysis, and the provision of the machinery for assisting colonial agricultural chemists to carry on soil research to a point beyond

that possible in their local laboratories.

As might well be expected, the assistance which soil survey work can give to irrigation problems comes out in several of the memoranda. Australia and the Union of South Africa both pay attention to the types of soil and the composition of the water suitable for irrigation, and the latter Dominion has some further interesting notes on exhaustion of soil by pine-apple

cultivation The Barbados review their own special soil problems connected with the sugar cane, whilst Ceylon discusses soil erosion, and Nyasaland the soil problems of tobacco growing. Altogether the memorandum presents a useful survey of Empire soil problems and will repay perusal by workers in Great Britain

#### STORAGE AND TRANSPORT OF AGRICULTURAL PRODUCE.

Matters of outstanding importance relating to the preservation and transport of agricultural produce, and in particular of perishable fruits of Australia, New Zealand, and South Africa, were discussed at the Conference. It has been pointed out that if the problems of immigration and land settlement are satisfactorily settled, the total production of foodstuffs from British colonies can be greatly increased. At the present moment, only some five per cent. of fruit produced in Australia is exported, while for New Zealand and South Africa the successful marketing of perishable food-stuffs, produced in great quantity, is still exceedingly difficult.

It is matter for congratulation for all concerned that arrangements have been made for Dr. Franklin Kidd, of the British Food Investigation Board, to visit Australia for the survey of local problems, the investigation work already in progress, and the possibilities of further work. It is anticipated that on the evidence of his report extensive lines of new in-

vestigation will be initiated

The cluef problems of transport for Australia relate to frozen lamb, mutton, beef, poultry, rabbits, and fruit, all of which present considerable difficulty. is well known, for example, that the time taken on the voyage from Australia to England is, in general, too long to enable the export of chilled beef to be commercially feasible; that this fact has for long been a serious handicap to the Australian cattle raising industry, and that owing to low prices realised for frozen materials, the ordinary method of freezing does not provide a way out of the difficulty. Much will depend on the matter of Dr. Kidd's report, as it is clear that improvements are called for in the pickling of meat, the treatment of slaughter-house wastes, and the defrosting of beef Regarding fruit, much valuable information is now available relating to brownheart in apples, the atmospheric and temperature conditions existing in ships' holds carrying apples from Australia, the storage properties of Victorian varieties of apples, and the incidence of the conditions known as 'bitter bit,' 'scald,' and 'internal breakdown'. The experience acquired in the investigation of such matters should be of infinite value when the problems of preservation and transport of oranges, pears, peaches, apricots, grapes, and tomatoes have been more fully assailed.

The problem of apple storage for New Zealand is also one of prime importance. The main damage to exported fruit is due to 'brown heart,' while in local storage there is extensive 'flesh-collapse' due to low storage temperature combined with high humidity. It is gratifying to note that improvements in storage have been assured and are further prefigured by the reduction in the water-content of apples. It cannot yet be said that the preservation of pears is satisfactory, but much practical success has followed storage at comparatively low temperatures. It has been shown that orchard conditions greatly affect the ability of the fruit to withstand bad storage conditions, and that in certain cases prematurity of the fruit tends to occur with extreme susceptibility to 'flesh-collapse.' It is hoped that this difficulty may be overcome by storage under relatively high temperatures and low humidity. It would further appear

that increasing the water-holding capacity of soils on which prematurity regularly occurs may enhance the resistance of fruit to 'flesh-collapse,' and that on such soils green manuring is decidedly advantageous.

In a paper to the Conference communicated by Dr. E. A. Griffiths, Government Physicist of the Department of Agriculture of South Africa, it was pointed out that it is neither practical nor sound to carry out investigations on fruit in England when such fruit has already undergone a period of long transport. On the other hand, the Dominions have neither the personnel of research workers nor the facilities for the conduct of the essential work urged that extensive investigation in England would help mainly to the understanding of the influence of respiration products on the storage of fruit and in the improving of technical methods in determining the conditions and effects of storage.

## AGRICULTURAL ECONOMICS.

In a paper presented to the Conference on "Research in Economics for Tropical Countries," it was pointed out that since the raising of crops is the main industry in tropical countries, research must be carried out in agricultural economics planters turn out partly manufactured produce, eg. sugar, coffee, or sisal, and are thus confronted by a twofold problem. At present more attention is usually paid to the economics of the factory than to agricultural economics, and thus the gain in the factory is largely discounted by loss in the field. When profits are good, work is often uneconomically performed, and thus when bad years come it is difficult to prevent disaster. In such cases the action necessary depends on the nature of the crop, though the general aim must be to control the quantity of produce reaching the market, e.g. coffee valorisation and rubber production restriction.

In the tropics, methods of research—which must be concerned largely with cost accounting-are usually simpler than in temperate climates, as it is usual to farm one main crop only and that generally for export. Research in agricultural economics is necessary, and should be a public charge To provide information, an agricultural census, the co-operation of planters, and the provision of agricultural colleges are required, while the formation of agricultural accounting societies like those at present under trial

m Wiltshire might be beneficial.

In a memorandum by Mr. W. J. Lamont, Chief of the Division of Agricultural Economics and Marketing, Union of South Africa, consideration was urged of a scheme to provide statistics and other information required by agriculturists seeking new outlets for their products. Lack of such information has been frequently felt, as, for example, when a South African commission was inquiring into the possibility of

increasing wine exports.

Some system is required whereby Britain and the Dominions may be provided with the latest available information about custom duties, trade agreements, restrictions on imports, and statistics of exports and imports, etc. Publication might be undertaken by the Empire Marketing Board or the Board of Trade Journal, with perhaps special supplements dealing with a different Dominion each month Probably the best method would be to issue a special annual volume with monthly or quarterly supplements. If an annual volume were published, a few special articles might be included on such subjects as the Canadian and American wheat pools, the compulsory pooling of tobacco in the Union of South Africa, or the wine trade of the British Dominions. In conclusion, Mr. Lamont urged that the adoption of some

such scheme would be of the greatest service to all the Dominions

SUGGESTIONS FOR CO-OPERATIVE RESEARCH.

In a comprehensive memorandum on "Co-operation m Agricultural Research," prepared for the Con-, ference by R W. Thornton, Director of Field and Animal Husbandry in the Union of South Africa, the following are among the subjects suggested as suitable for research on co-operative lines in various parts of the Empire (a) The farming of Angora goats for the production of mohair, an industry which has seriously declined in recent years, (b) the relative cost and efficiency of horse versus mechanical transport for various farm purposes; (c) 'rust' m wheat, the principal factor limiting the production of this most important crop; (d) the production of legumes, particularly the soya bean, which could be grown in rotation with maize and might be produced in equal quantity in those parts of the Empire where maize is largely grown, (e) the ocean transportation of live-stock and agricultural products with the view of greater uniformity in regulations.

## University and Educational Intelligence.

Bristol — The opening of the new physics laboratory by Sir Ernest Rutherford on Oct. 21 was marked by a notable address by him on the significance of fundamental research and the splendid facilities which the laboratory affords for its pursuit. "Under such excellent conditions," he remarked, "we may confidently anticipate that this laboratory will fulfil the wishes of the donor by developing into one of our most important centres of training and What is now needed is the endowment of a number of research fellowships of about £250 a year each, to enable young men or women who have shown marked ability for research to carry out investigations in the laboratory.

At a special congregation held in the great hall of the University on Oct. 21, Prof. A. M. Tyndall, Henry Overton Wills professor of physics in the University, presented to the Chancellor, Lord Haldane, the following distinguished men of science for the honorary degree of doctor of science: Prof. Max Born, professor of theoretical physics, Gottingen; Sir William Bragg, director and Fullerian professor of the Royal Institution; Prof. A. S. Eddington, Plumian professor of astronomy, University of Cambridge; Prof. A. Fowler, Yarrow professor of the Royal Society; Prof P. Langevin, professor of general and experimental physics, College de France, Paris; and Sir Ernest Rutherford, Cavendish professor of experimental physics, University of Cambridge, and president of the Royal Society.

CAMBRIDGE.—It is announced that Sir Arthur Shipley bequeathed some of his library to the Molteno Institute, the Balfour Library, and the Cambridge Philosophical Society.

Mr. F. R. Parrington, Sidney Sussex College, has been appointed Assistant to the Superintendent of the Museum of Zoology.

A grant of £150 has been made from the Worts Fund on the recommendation of the Polar Research Institute committee to the recent Cambridge expedition to Edge Island, Spitsbergen.

Mr. Norman McLean, fellow and tutor of Christ's College, and University lecturer in Aramaic, has been elected master of the College in succession to the late Sir Arthur Shipley.

LEEDS —The University Council has placed on record its grateful indebtedness to Sir Edward Allen

Brotherton, Bart., for his munificent generosity towards the University The New Library Building, to be called 'The Brotherton Library,' will link the name of Sir Edward Brotherton inseparably with the history of the University. An offer by Messrs. Briggs, Son and Company to provide funds for a Scholarship of £150 a year, tenable in the Mining Department for a period of five years, has been gratefully accepted.

LONDON.—The following doctorates have been conferred by the Senate · D Sc. in chemistry—Mr. J. W. Baker, an internal student of the Imperial College (Royal College of Science), for a Thesis entitled "A Correlation of the Effect of Certain Groups on the Reactivity of Aliphatic and Homocyclic Substitution." D.Sc in physics—Mr. R E. Gibbs, an internal student of University College, for a thesis entitled (1) "The Variation with Temperature of the Intensity of Reflection of X-rays from Quartz and its Bearing on Crystal Structure", (2) "The Structure of a-Quartz"; (3) "The Polymorphism of Silicon Dioxide and the Structure of Tridymite"; (4) "An X-ray Investigation of the Lower Members of the Fatty Acid Series". D.Sc (engineering)—Mr. G W Burley, an external student, for a thesis entitled "An Investigation into the Temperatures and Thermal Quantities involved in Lathe Turning Operations on Plain Carbon Steel," and other papers

The Gow Lectures on the "Colloid Chemistry of the Rubber Industry" will be given, in English, by Dr E A. Hauser, of Frankfurt-on-Main, at University College, at 5 15 on Nov. 7, 9, 11, 14, 16, and 18 Free lectures on "Statistical Mechanics Old and New" will be given by Mr. R. H. Fowler, at the Imperial College of Science and Technology, on Nov. 10 and 24 and Dec. 8, at 5.45. No tickets will be required in either case

ONFORD—On Friday, Oct 21, the Rockefeller School of Biochemistry, described elsewhere in this issue, was opened by Viscount Cave, the Chancellor of the University, in the presence of a large gathering which assembled in the Sheldoman Theatre to hear the Chancellor's address, and afterwards accompanied him to the fine new building in the Parks in which the School is housed. The Vice-Chancellor (Dr. Pember, Warden of All Souls'), in accepting the gift on the part of the University, gave expression to the gratitude due to the generosity of the Rockefeller Trust, and to the anticipation of the great results that might be expected to follow from the splendidly equipped department under the charge of the Whitley professor, Prot. R A Peters.

Dr. Gilbert Bourne, of Merton College, has been reappointed an elector to the Linacre professorship of zoology and comparative anatomy. Mr. David Murray-Rust has been appointed lecturer in natural science at Balliol College.

According to the report of the Institute of Agricultural Engineering for 1926 which has just been presented to congregation, the principal work of the institute was in connection with the desiccation process for producing sugar from beet. The work on sub-soiling has been continued.

It is announced that the postponed fifth Pan-American Child Congress, referred to in our issue of April 16, p. 583, will be held at Havana, Cuba, beginning on Dec 7, next.

PROF. MAX PLANCK, the well-known professor of physics of the University of Berlin, is retiring after forty years' service. He will be succeeded by Dr. Erwin Schrödinger, of the University of Zurich.

## Calendar of Discovery and Invention.

October 30, 1786.—So early as 1780, Galvani made experiments on muscular contractions due to electric Pursuing his studies in 1786 with his nephew Camillo Galvani, in September of that year it was observed that these contractions could be brought about by the use of metals touching the nerves. The experiments with the exact dates are preserved in a paper in Galvani's handwriting, "Esperimenti circa l' Elettricità dei metalli"; and the results were formally drawn up in a Latin dissertation of 62 pages, bearing the date Oct. 30, 1786, forming the substance of the most important section of his "Commentary on the Electric Forces .." published five years later but differing from it in some important particulars.

October 31, 1896.—Thrrty-one years ago, on Oct. 31, 1896, Prof. Kamerlingh Onnes communicated to the Royal Academy of Sciences, Amsterdam, a paper by Dr. Zeeman "on the influence of magnetisation on the nature of the light emitted by a substance. Pursuing a hint given by Faraday, several experiments were tried. The principle was this, the light of the electric arc being sent through a heated tube containing sodium vapour, is analysed by a Rowland's grating. The tube is placed between the poles of an electro-magnet. When acted on by the magnet, a slight broadening of the two sodium lines is seen, tending to show that forced vibrations are produced m the atoms by the action of magnetism ' (see Nature, Dec. 24, 1896, p. 192)

November 1, 1895—The first experiments with a

cmematograph in Germany were made by the photographer, Max Skladanowsky, on Nov. 1, 1895, in the Wintergarden at Berlin.

November 4, 1745.—It was the attempt to electrify water in a phial which led to the invention of the Leyden jar, an invention which Sir John Leslie described as constituting an epoch in the annals of science. The discovery was made by Ewald Jürgen von Kleist at Cammin, Pomerania, and by him communicated to the German physicist Lieberkuhn on Nov. 4, 1745. The experiments were immediately repeated by Cuneus and Lallemand at Leyden and described by Musschenbroeck. Von Kleist was a president of the high court of justice, and the house he lived in at Cammin bears an inscription to the memory. He was born on June 10, 1700, and died on Dec. 10, 1748.

November 4, 1847.—The use of anæsthetics began with the discovery of the action of nitrous oxide by Davy, but a new era in surgery was ushered in by the work of Morton, at Boston, Mass., in 1846, with sulphuric ether, the news of which led to Simpson's experiments. Late on the evening of Nov. 4, 1847, Simpson and his friends Keith and Duncan sat down to the hazardous experiments in Simpson's diningroom, which resulted in the discovery of the value of chloroform. "With each tumbler newly charged, the mhalers resumed their vacation" They became hilarious, bright-eyed, loquacious, "but suddenly there was a talk of sounds-louder and louder-a

moment more, then all was quiet, and then a crash."

November 4, 1869.—Founded by Sir Norman
Lockyer, Nature first appeared on Nov. 4, 1869. Writing in the Jubilee number, M Deslandres said. "During its existence the journal has ably recorded the magnificent discoveries which have distinguished the last fifty years in every branch of science . . . and it has been the better able to present them to the public because the founder has himself been one of the foremost builders of this noble edifice"

## Societies and Academies.

#### LONDON.

Optical Society, Oct. 13-L. C. Martin: Experiments in ultra-violet refractometry. The experiments described have for their object the application of critical angle methods for the refractometry of liquids in the ultra-violet. A thin film of liquid can be held between two quartz hemispheres which are traversed centrally by an approximately parallel beam; the film receives the radiation at the varying angles of incidence resulting on rotation of the system. In this way, analysing the transmitted radiation with the aid of a quartz spectrograph, the critical angles for definite wave-lengths are measured, from which refractive indices can be calculated. The procedure necessary in seeking precise results is discussed, and a series of measurements on glycerine-water mixtures likely to be useful for immersion fluids in ultra-violet microscopy is given A set of interesting phenomena of the extinction bands is described and explained —Guy Barr. The construction of wave-length scales for spectrograms A method is described by which an approximate scale of wave-lengths may be projected geometrically from a uniformly divided scale on to a spectrogram whereon a sufficient number of lines have been identified to enable constants of a Hartmann interpolation formula to be derived. Such a scale is of value in assisting the recognition of other lines between which accurate interpolation may be required.

#### ROME.

Royal Academy of the Linces, June 1.—A. Lo Thermionic balance.-L. Rolla and G. Piccardi: Ionisation potential of terbium. By comparison with sodium and calcium, the ionisation potential of terbium is found to be 6.74 volts. This value talls into place on the portion of the ionisation potential curve characteristic of the rare earths, and furnishes further confirmation of the conclusion that, in the rare earth group, such potential increases with the atomic number.—A. Angeli and B. Bigiavi . The two p-nitroazoxybenzenes. When treated with bromine in the presence of a small amount of iron filmgs, the two p-nitroazoxybenzenes behave differently, the isomeride melting at 148° yielding a tribromo-compound, and that melting at 152° a monobromo-derivative.—G Bruni and E. Geiger: New derivatives of caoutchouc. The action of nitrosobenzene and other nitroso-compounds on caoutchouc in benzene solution or on the latex of Hevea brasiliensis in pyridine solution results in the formation of compounds termed nitrones. These do not react with hydroxylamine, but with phenylhydrazine the nitrone of isocaoutchouc yields the phenylhydrazone of a ketone which contains the carbonyl in the caoutchouc chain.—F. Zambonini and S. Restaino: Double sulphates of rare earth metals and alkalı metals. (8) Double sulphates of cerium (cerous) and sodium. The compounds  $Ce_2(SO_4)_3$ ,  $Na_2SO_4$ ,  $2H_2O$  and  $4Ce_2(SO_4)_3$ , 5  $Na_2SO_4$ ,  $8H_2O$  are described.—F. Zambonini and A. Stolfi: Double sulphates of rare earth metals and alkali metals. (10) Sulphates of neodymium and ammonium. Under the various experimental conditions employed, only the compound  $Nd_2(SO_4)_3$ ,  $(NH_4)_2SO_4$ ,  $8H_2O$  could be detected.—L. Cambi: The diazohydrates. The available facts concerning the structure of the alkali salts of the normal diazohydrates are in no way contradictory to the structural formula attributed to the hydrates by Angeli, but do not agree with Hantzsch's view of this structure -L. De

Marchi. The origin of the thermal waters of Montegrotto - B. Morpurgo: The influence of manition on homoplastic grafting. -C. Rosati: The permutable correspondences for an algebraic curve.—L. Laboccetta: A general method for replacing an inequality and a limitation by an equation, and its use m analytical geometry. E. Pin: Investigation of the primitive function for functions of several variables. - G. Thomsen: The kinematics of rigid bodies in general relativity .-- A. Masotti: Dynamic action which a perfect liquid exercises on a solid eylinder, of any section, movable of itself.-F. Sbrana Plane motions of an incompressible fluid in which the lines of flow are isotachic. -G B. A new variable star. -F. Neri: Certain Lacchini properties and applications of the neon lamp. Observations on the relationship between the effective ignition voltage for a neon lamp under alternating current and the frequency of the current indicate that the phenomenon of ignition requires a certain time and that the ignition of one electrode is profoundly influenced by the state of ionisation in which the medium has been left by the other. - ({ Charrier: Organic compounds of quinquevalent bismuth. In hydrochloric acid solution, bismuth trichloride reacts with aryldiazonium chlorides to form stable crystalline compounds which contain quinquevalent bismuth and in which the chlorine atoms are readily replaceable by sulphure or intric residues. G. Malquori Hydrates of aluminium nitrates. From the cryohydre point for the system,  $Al(NO_3)_3 \cdot Il_2O$ , namely, -27°, to 73° 5, at which temperature the monohydrate melts, the only compound in equilibrium with the saturated solution is Al(NO<sub>3</sub>), 911,0. At higher temperatures, the solubility curve exhibits marked discontinuity, corresponding with the existence of two hydrates poorer in water and the octo-and the hexa-hydrate. -- V. Caghoti and A. Stolfi: Double sulphates of bismuth with the alkalı metals. (1) Sulphates of bismuth and potassium. Investigation of the system,  $\mathrm{Bi_2(SO_4)_3} - \mathrm{K_2SO_4} - \mathrm{H_2O}$ , indicates the existence of the compound  $\mathrm{Bi_2(SO_4)_3}$ ,  $3\mathrm{K_2SO_4}$  but not that of  $\mathrm{KBi(SO_4)_2}$ .—Remo de Fazi: Alcoholic fermentation of solutions of glucose in water exposed to radiations from a moreury vapour lamp. Exposure of water to the radiation from a quartz mercury vapour lamp results in increase of the velocity of fermentation of a solution of glucose in the water.—A. Cavinato: Dehydration of anophyllite.—E. Remotti: Assumption of vitellin during the embryonic development of the fowl. -B. de Finetti: Conservation and diffusion of Mondelian characters. (1) Panmittic case —M. Muccioli Astringent juice of the fruit of the bitter Diospyros kaki and its application in China and Japan as an impregnating material for paper and wood.

### BRUSSELS.

Royal Academy of Belgium, April 2. -The following grants were made from the Potter Foundation; W. Conrad (2000 franes) to assist him in the pursuit of his researches on the Belgian fresh water flagellates; J. Pasteels (500 francs) for the study, at Wimereux, of the cyto-physiological action of the dilution of sea water on the eggs of lamellibranchs; the "Jardin expérimental Jean Massart" (5000 francs) for the continuation of experiments in plant physiology commenced by the late Jean Massart; Edg. Zunz (6000 francs) for the purchase of apparatus necessary for his researches on the regulation of glycæmia by the method of pancreatico-jugular anastomosis; Th. De Donder (7500 francs) for assisting in the publication of a work on the theory of integral invariants; Gilta (1000 francs) for the execution of

plates 'relating to chemical crystalligraphy.—Paul Stroobant: The work on stellar and planetary photography of the Royal Observatory (Uccle)—Fred. Swarts Trifluordimethylketone. This is readily obtained by heating trifluoracetylacetic ester with 10 per cent. sulphuric acid under a reflux condenser. the products being the above ketone, alcohol, and carbon dioxide. Details of its chemical and physical properties are given—J E. Verschaffelt. The physical signification of the second fundamental law of thermo-dynamics.—Th De Donder The signification and generalisation of Schrodinger's equation.—
The De Donder and G Van Lerberghe: The invariantive theory of waves—R Moens and A Juliard. Some chemical reactions in the gaseous phase in high frequency electro-magnetic fields. The gases studied were submitted to high frequency (wave-length about 100 metres) in tubes without electrodes, initial pressure about 12mm Hydrogen and oxygen combined totally in less than a second, ammonia was produced from hydrogen and nitrogen No reaction was observed with a mixture of hydrogen and carbon monoxide or oxygen and nitrogen -T. Van Hove: Some researches on the direct introduction of substituents in the aiomatic mercaptans -L Van den Berghe · Preliminary note on the stimulation of the cardiac tissue of fishes by momentary extensions — J Guillissen . A mode of application of Tammann's method of thermal analysis to the study of reactions between solid phases. To increase the sensitiveness of the method the use of the nime-temperature curve has been replaced by the curve temperature-difference of temperatures, using the double galvanometer of Le Chatelier-Saladin. The reaction temperatures of the following mixtures have been determined by this method: lead oxide-copper sulphate, lead oxidemolybdic anhydride, ferric oxide-barium carbonate, ferric oxide-baryta, ferric oxide-calcium carbonate. -J Guillissen and Richard: The temperature of formation of zinc ferrite starting from the solid constituents

May 3 -P. Stroobant: An account of the work done by the National Committee of Astronomy during the year 1926 -- Seligmann and Maury: The geodesic work of the Institut cartographique militaire in 1926 -Paul Levy. Classical logic. Brouwerian logic and mixed logic -Louis Giltay: The discovery of a species of Gobius, new to Belgium (Gobius pictus) and on the ethological conditions of its habitat.

#### SYDNEY.

Royal Society of New South Wales, Sept 7.—A. R. Penfold and F. R. Morrison. The essential oils of *Eucalyptus micrantha* and *E. hæmastoma*, part i. The principal constituents were found to be. E. hæmastoma: Eudesmol, sesquiterpenes (aromadendrene and probably eudesmene), d-a-pinene, cincol (10-15 per cent.) with a very small quantity of phellandrene. E. micrantha I-a-phellandrene. sesquiterpenes, terpineol and piperitol and their Caproic acid esters, d-a-pinene, cineol (less than 10 per cent.), with sesquiterpene alcohols and traces of the aromatic aldehydes. Piperitone, if present, did not exceed 5 per cent. in quantity. Solid eudesmol, a characteristic and constant constituent of the oil of E hamastoma, was found only in the oil obtained from Hill Top; altitude has a considerable bearing upon the production of this solid sesquiterpene alcohol. The presence of solid eudesmol in the coastal material of *E. hæmastoma* and the nondetection of phellandrene in the crude oils by the B.P. test, offered a ready means of distinguishing the oils from that of E. micrantha.

## Official Publications Received.

#### BRITISH.

The Journal of the Royal Anthropological Institute of Great Britain and Ireland Vol 57, 1927, January to June Pp 248+5 plates (London)

Annals of the (Mededelingen van het) Transvaal Museum Vol 12, att 2,22 September 1927 Pp 55-189+plates 3 7 (Cambridge Printed Part 2, 22 September 1927 at the University Press)

Part 2, 22 September 1927 Pp 55-189+plates 3.7 (Cambridge Printed at the University Press)

Empire Cotton Growing Corporation Cotton Growing in Southern Africa and the Phodesias Report on a Tout undertaken in Southern and Central Africa by the Director, Mr. J. S. Addison, and Mr. H. C. Jefferys, April-June 1927 Pp 31+8 plates (London) 2s.

(University of London) Count Councils of Kent and Surrey The Journal of the South-Eastern Agricultur il College, Wye, Kent, Edited by Dr. S. Graham Brade-Birks. No. 24. Pp 196 (Wye) 7s. 6d; to Residents in Kent and Surrey, 3s. 6d.

Proceedings of the Royal Society of Edimburgh. Session 1936-1927. Vol. 47, Put. 2, No. 1s. On the Consistency of Cardinal Function Interpolation, Parts 1 and in. By W. L. Fairia. Pp. 239-242. 1s. Vol. 47, Put. 2, No. 1s. On the Consistency of Cardinal Function Interpolation, Parts 1 and in. By W. L. Fairia. Pp. 239-242. 1s. Vol. 47, Put. 2, No. 1s. On the Consistency of Cardinal Function Interpolation, Parts 1 and in By W. L. Fairia. Pp. 239-242. 1s. Vol. 47, Part 3, No. 1s. Observations on the Fragment of a Horse Skull from an Interplacial Disposit near Pulawy, Poland. By R. Prawochenski and B. Kaczkowski. Pp. 243-251+1 plate. 1s. (Edimburgh. Robert Grant and Son., London. Williams and Nongate, Ltd.).

Aeronautical Research Committee. Reports and Memoranda. No. 1064 (Ae. 245). Model Experiments on R.A.F. 31 Aerofold with Handley Page Slot. By H. B. Ilving, A.S. Batson and D. H. Williams. (A. 3a. Aerofolds General, 168—T. 2335.). Pp. 8+1 plates. 6d. net. No. 1094 (Ae. 240). The Edects of Stagger and Gap on the Aerodynamic Properties of Biplanes at Lurge Angles of Incidence. By H. B. Ilving and A.S. Batson. (A. 2a. Stability Calculations and Model Experiments, 116 and 123—T. 2334, T. 2357.). Pp. 37+20 plates. 1s. 1s. 1nt. No. 1094 (Ae. 273). A.F. Thill Scale Determination of the Angle of Downwash below and Aeroplane. By E. T. Jones. (A. 4a. Full. Scale Work. Aeroplanes-General, 185—T. 2457). Pp. 64+2 plates. 6d. net. No. 1096 (Ae. 273). A.F. Thill S

#### FOREIGN

Report of the Aeronautical Research Institute, Tokyo Imperial University No 26 Some Experiments on Motions of Fluids, Part iv By Totalitko Terada and Kunno Hattori. Pp. 287-326+plates 8 20. (Tokyo Kossikai Publishing Office) 1.15 yen Institut Royal Meterologique de Belgique Memoires, Vol. 2 Sui la distribution de la pluie en Belgique. Par Emile Vanderlinden. Pp. 30+7 planches (Bruxelles)
Bernice P. Bishop Museum. Bulletin 34. Polynesian Religion. Bv. E. S. Craighill Handy. (Bayard Dominick Expedition, Publication No. 12). Pp. 312. 3 dollars. Bulletin 35. Geology of Kaula, Nihos, Nicker and Gardine Islands, and French Frigates Shoal. By Harold S. Palmer. (Tanager Expedition, Publication No. 1). Pp. 35+3 plates, 1 dollar. Bulletin 36. Geology of Mangaia. By P. Marshall. Pp. 48+3 plates. 1 dollar. Bulletin 37. Fool Values of Poi, Taro and Limi. By Caney D. Miller. Pp. 25. 1 dollar. Bulletin 38. Fishes of the Tropaci. Central Pacific. By Henry W. Fowler. (Whippoor will Expedition, Publication No. 1.). Pp. 32+1 plate, 1 dollar. Bulletin. 36. String Figures from Fig. and Western Polynesia. By James Homell. Pp. 88. 1 dollar. Bulletin. 40: Hawanian Mosses. By V. F. Brotherus. Pp. 37. +8 plates. 1 dollar. (Honolulu, Hawaii.)

#### CATALOGUES

South Africa Catalogue of Books, Paintings and Drawings, relating to Cape Colony, Transvaal, Orange Free State, Rhodesia, South West Africa, Natal, British Central Africa, Mashondiand, Angola, Matabelland, Zambesia, etc. (No 501) Pp 45 (London Francis Edwards, Ltd)
High-Tension Cable Testing and Fault Locating Pp 24. (London

Watson and Sons (Electro-Medical), Ltd )

## Diary of Societies.

#### SATURDAY, OCTOBER 29

MINING INSTITUTE OF SCOTLAND (at Heriot Watt College, Edinburgh), at 3.

—D. Davidson' The Transport of Injured Persons Underground —
Papers open for discussion —Experiments concerning the Relationship
between Ventilating Pressure and Au Volumes in Mines, and the
Effect of Natural Ventilation, by Prof H Briggs, Dr J. M.
Williamson, Dr J S Penman, and H Hyde; Miners' Nystagmus,
by Di J. S Haldane and Dr. T. L Llewellyn, An Improved Face
Conveyer, by A V Reis.
North of England Institute of Mining and Mechanical Engineers
(Associates and Students' Section) (at Newcastle upon-1yne), at 3 —
W S Rider Feeding and Treatment of Animals below Ground and
Stabling.—Paper open for further discussion —Variable Speed Gears
and their Application for Colliery Purp ses, by W. S Armstrong
Hull Association of Engineers (at Municipal Technical College, Hull),
at 715—W S. Burn. Notes on the Development of an Oil Engine
(Lecture)

(Lecture)

#### MONDAY, OCTOBER 31.

INSTITUTE OF ACTUARIES, at 5.—Sir Joseph Burn The Eighth International Congress of Actuaries

Institute of Chemical Industry (Yorkshire Section) (jointly with Institute of Chemistry, Leeds Area Section) (at University, Leeds), at 715—O C de C Ellis Flame University of Birming-Ham Chemical Society -R S Tipson . Poisons.

#### TLESDAY, NOVEMBER 1

ROYAL INSTITUTION OF GREAT BRITAIN, at 5:15—Sit John Herbert Parsons Light and Sight (Tyndoll Lectures)(1) Manchester Literary and Philosophical Society, at 5:30—J N Langdon and Edna M Yates Transier of Training in Manual Langdon and Edna M Dexterity

Dexferity

MINERALOGICAL SOCIETY (Anniver-city Meeting), at 5 20—Di L J
Spencer (i) Specific Gravities of Minerals an Index of Some Recent
Determinations (i) South African Occurrences of Willemite Fluorescence of Willemite and some other Zinc Minerals in Ultra-violet
Rays—Dr T V M Rao A Study of Bauvite—Dr P K Ghosh On
the Biotite bearing Greenstones and on a Rhyolitic Pumice in the
Metamorphic Aureste of the Falmouth Granite
Zoological Society of London, at 5 30—F Martin Duncan Exhibition of Ginematograph-him of Chimpanzees now in the Society's
Collection—W N Biair Notes on Hirwio indications, the Medicinal
Leech, as a British Species—Major R W G Hingston Fieldobservations on Spider Minnics.—Miss Mary L Hett Some Land
Nemerteans from Upolu Island (Samoa), with Notes on the Genus
Geomemertes

Geonemertes

INSTITUTION OF CIVIL ENGINEERS, at 6 -E F C Trench Presidential

Inaugural Address
Institution of Electrical Engineers (North-Westein Centie) (at Midland Hotel, Manchester), at 7 - A B Mallinson. Chairman's

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7—B Cox Some Negatives and why I made them (slides by A C Banneld).

Banheld).

INSTITUTION OF BLECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.15 — J E Stoil: Chairman's Address Society of Chemical Industry (South Wales Section) (at Technical College, Cardiff), at 7.30 — T Lewis The Care of the Byes in Industry INSTITUTE OF MITALS (North-East Coast Local Section) (at Armstong College, Newcastle-upon-Type), at 7.30 — G Burns. Mechanical Properties of Metals at High Temperatures

ROYLA NUMBEROPOLOGIAL INSTITUTE AT SO — Even atom of a Mousterian

ROYAL ANTHROPOLOGICAL INSTRUCTS, at S 30—Evervation of a Mousterian Site at Devil's Tower, Gibraltar—Miss Dorothy Garrod Archeology and Palæontology—L H Dudley Buxton Human Remains—Prof Elliot Smith. The Endocianual Cast

#### WEDNESDAY, NOVEMBER 2

WEDNESDAY, NOVEMBER 2

ELECTRICAL ASSOCIATION FOR WOMEN (at E L M A. Lighting Service Bureau, 15 Savoy Street, W.C.2), at J.—E E. Sharp Time Switches Royal Institute of Public Health, at J.—Sir Henry Gauvain. Tuberculosis as a Problem of Childhood GEOLOGICAL SOCIETY OF LONDON, at 5 30 —Dr. J. A. Douglas and W J. Arkell: The Stratigraphical Distribution of the Combrash. I The South-Western Area Institution of Electrical Engineers (Wireless Section), at 6—Lt.—Col. A. G. Lee Chairman's Inaugural Address British Psychological Society (General Meeting, jointly with the Industrial Section) (at Royal Anthropological Institute), at 6—Dr. W. V. Bingham Some Individual Differences in Susceptibility to Accidents Accidents

Accidents
Institution of Automobile Engineers (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7—Major E G Beaumont The Influence of the Automobile User upon the Automobile Engineer (Presidential Address)

Electrical Association for Would (at ELMA Lighting Service Bureau, 15 Savoy Stiect, W C 2), at 7—W. E Bush The Principles of Good Home Lighting

INSTITUTION OF ELECTRICAL ENGINEERS (Teas Sule Sulp Centre) (at Cleve.

of Good Home Lighting
INSTITUTION OF ELECTRICAL ENGINEERS (Tees Side Sub-Centre) (at Cleveland Jechnical Institute, Middlesbrough), at 7.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Carton Hall, Westminster), at 7—W. C. Freeman: The Production and Modern Applications of Dissolved Acetylene.
ROYAL Society of Arts, at 8—Sir Philip Magnus, Bart.: The Royal Society of Arts its Services to Trade and Training (Inaugural Addless)

Address)

Addless)

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.—F. W. Edwards Narrative of a Collecting Trip to Patagonia and South Chile

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (In Institute of Pathology and Research, St Mary's Hospital), at 8 15.—Sir William Willow The Biological Tests for Blood —Dr. G. Roche Lynch The Technique of the Precipitin Test and its Forensic Value —Dr. F. C Martley: The Use of the Blood Grouping Reactions in Forensic Investication

-Dr. F. C. Martiey: The Use of the Blood Glosging Forensic Investigation ROYAL SOCIETY OF MEDICINE (Surgery Section) (at Royal College of Surgeons), at 8.30 —Sir Arthur Keith: Concerning the Origin and Nature of Osteoblasts.

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

#### THURSDAY, NOVEMBER 3.

ROYAL SOCIETY, at 4.30 — Prof. Hans Spemann: Organisers in Animal Development (Croonian Lecture)
ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 — Dr. J. F. Gaskell.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5—Dr. J. F. Gaskell. The Pathology of Pneumonia (Bradshaw Lecture)
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Dr. G Parker: The Early Development of Hospitals (Thomas Vicary Lecture).
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15—H Chiford Smith. The Furniture and Equipment of the Mediæval House (1).
INSTITUTION OF ELECTRICAL ENGISEERS, at 6—A. H Law and J. P. Chittenden: Higher Steam Pressures and their Application to the Steam Turbing.

Society of Chemical Industry (Bristol Section) (at University, Bristol), at 7.30 —H. H. S. Clotworthy The Manufacture of Viscose Artificial Silk

INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Royal Aeronautical Society) (at Royal Society of Aris), at 7.45—H. B Taylor: High-Speed Compression—Ignition Engine Research.

CHEMICAL SOCIETY, at 8—F G Mann The Complex Salts of Nickel with Various Aliphatic Diamines—T K Walker, V. Subramaniam, and P Challenger The Mechanism of the Formation of Citric and Oxalic Acids from Sugars by Aspainlius Nigo.—W R Buckinall and W Wardlaw The Complex Cyanides of Molybdenum—F B Gainer and S Sugden The Parachor and Chemical Constitution—Part VI. Some Cases of supposed Ring chain Tautomenism.

Society of Dyers and Colourists (West Riding Section)—Prof E C C Baly—The Synthesis of Sugars from Carbonic Acid by Means of Light

Baly Light

Light Institution of Mechanical Engineers (Glasgow Branch) — G  $\,$  K. Nichol Surface Condensing  $P_{-}^{\rm L}$ 

#### FRIDAY, NOVEMBER 4

ROYAL ASTRONOMICAL SOCIETY, at 5—Geophysical Discussion Earthquakes Chairman Prof H H Turner Speakers Dr H. Jeffreys, R D Oldham, Mr Stoneley, and others
Institution of Mechanical Engineers, at 6—Sir William H Braug-Application of X-Rays to the Study of the Crystalline Structure of Materials (Thomas Hawksley Lecture)
Society of Chemical Industry (Manchester Section) (jointly with Institute of Chemistry (Manchester Section), Society of Dyers and Colourists (Manchester Section), and Manchester Literary and Philosophical Society (at Blackmar House, Manchester), at 7—Prof. A E Green Some New Principles in Chemo-therapy
Royal Photographic Society of Great Britain (Informal Meeting of Pictorial Group), at 7—An Evening with W L. Shand Junior Institution of Engineers, at 7:30—R. Lowe Engineering Salesmanship.

Salesmanship.

North-East Coast Institution of Engineers and Shipbuilders (at Newcastle-upon-Tyne)

#### SATURDAY, NOVLMBER 5

ROYAL INSTITUTION OF GREAT BRITAIN, at 3—E Cammaerts The Main Features of Modern English Literature (1) GEOLOGISTS' ASSOCIATION (at University College), at 3.—Annual Conversazione

#### PUBLIC LECTURES.

#### SATURDAY, OCTOBER 29

Horniman Museum (Forest Hill), at 3 30.-M A Phillips Nature at Home

#### MONDAY, OCTOBER 31

King's College, at 5-30 —Prof E Cassirei Die Entwickelung der modernen Wissenschaft und die Grund-Prinzipien des kritischen Idealismus. (Succeeding Lectures (in German) on November 2 and 1)

#### TUESDAY, NOVEMBER 1

ST MARY'S HOSPITALS, WHITWORTH STREET WEST BRANCH, MANCHISTER, at 4 15 - Dr. H. C. Cameron: The Child in General Practice: a Study both of Temperament and of Disease (Lloyd Roberts Lecture). Gresham College, at 6 - W. H. Wagstaff. Geometry. (Succeeding Lectures on November 2, 3, and 1)

#### WEDNESDAY, NOVEMBER 2

University College, at 5—Dr. R. Hopkins - The Roots of Character. — At 5-30—Major C. Davenport . Nineteenth Century Methods of Book Illustration - The College of the Colle

King's College, at 5 30.—R. F. Cholmeley Secondary Education, 1: The Boys' Day School.

LONDON SCHOOL OF ECONOMICS, at 6 —P T Lloyd: Office Machinery The Graphic Method and its Technique

#### THURSDAY, NOVEMBER 3.

ROYAL SOCIETY OF MEDICINE (in Barnes Hall), at 5 — Dr L Colledge The Present Position of Laryngectomy for Cancer of the Laryny

(Semon Lecture)
UNIVERSITY COLLEGE, at 5 30 — Dr R. Hopkins: The Use of Interature to Influence Conduct: Some Effects of reading Poetry

#### FRIDAY, NOVEMBER 4.

BIRKBECK COLLEGE, at 8—Public Debate on Humane Slaughtering.—Speakers: A. C Dewbury and A. C Knight Chairman Prof. F T C Hobday.

#### SITURDAY, NOVEMBER 5.

Horniman Museum (Forest Hill), at 3.30 -II Harcourt Indian Pictures and Pioblems.

#### CONGRESSES.

ANNUAL CONFERENCE OF SOCIOGICAL SOCIETY, LEPLAY HOUSE, AND THE TOURS ASSOCIATION (at Royal Society of Arts)
At 11 a m.—A Farquharson Some New Points on Survey Method —
G Morris Studies in the Auvergne The High Pyrenees
At 3.—Miss Vivian M. Palmer. The Survey of Chicago \*
At 5 30 —Field-Studies in Tirol (Speaker from the Leplay House Students' 'Camp,' 1927)

#### OCTOBER 29 AND 30.

ROUMANIAN CONGRESS OF OTO-RHINO-LARYNGOLOGY (at Bucarest)



## SATURDAY, NOVEMBER 5, 1927.

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No. 3027, Vol. 120]

## Empire Cotton Supply and Needs.

THE Lancashire cotton industry is, as is well known, in a somewhat parlous condition, and one important factor involved is that it has not control over its supplies of raw material. About one-third is grown in Egypt and South America, and two-thirds are from the United States; but the cotton of these two sections is so different that two separate industries deal with it in Lancashire. The first appears to be fairly prosperous, but the larger industry, dependent on the United States supply, is in trouble. This supply fluctuates enormously, and demands from elsewhere are increasing rapidly. During the past five years the crop has varied from 11 to 18 million bales. cotton mills are springing up in many countries, and those in America alone now require about half the crop These figures indicate sufficiently how precarious is the position of the bulk of the Lancashire cotton mills

This state of affairs has, however, been long predicted; and more than twenty years ago a British Cotton Growing Association was formed, to encourage growing American cotton within the Empire, chiefly by assistance in marketing the produce Since the War, matters have become acute; and about five years ago a much more ambitious scheme was launched, namely, the Empire Cotton Growing Corporation, which sought to stimulate the mill owners to united action, by a levy of 6d. on each bale of cotton entering Great Britain. When the participation of a large proportion of the mill owners was secured, the Government endowed the movement with close on one million pounds, saved through the control of the Egyptian cotton during the War, and an Act of Parliament was passed sanctioning the levy for five years. This period is now terminating; and the Lancashire industry concerned is about to be sounded as to whether the levy should be continued.

It will be of interest to note how this Corporation, mainly composed of business men, has set about its task. A central office was opened in London, a library collected, and an excellent quarterly journal started. Senior officers were sent on surveys of various parts of Africa, India, and Australia, and their reports have been freely circulated. In Africa the transport problem dominates, and large sums of money have been spent on improving communications. In India a large model estate has been assisted and financed in the Punjab, for the encouragement of growing American cotton; and in Australia £3000 a year has been given for five years for founding cotton stations.

The most interesting point, however, is the appreciation of the Corporation of the need for scientific work A central Research Institute has been built in Trinidad, and the local College liberally subsidised. A number of post-graduate scholarships have been given on a generous scale to encourage recruitment, and four research institutions in Great Britain have received £1000 a year for five years, to assist in training these men Senior officers, largely with Indian cotton experience, were engaged to start the work in the colonies, and the trained men have been drafted out in succession In the circumstances, judging by the annual reports now coming in, progress has been remarkably rapid, although it is recognised that it will be many years before the goal is reached—of making the Empire self-sufficient as to its cotton requirements to be hoped that the Lancashire mill owners will vote for a further five-year period of the levy. The ball has been set rolling, but there are many obstacles in its path; and the co-operation of this powerful and broad-minded Corporation cannot be overestimated. C. A. B.

## Biology and Birth-Control.

 University of London: Galton Laboratory for National Eugenics. Eugenics Lecture Series, 14. The Right of the Unborn Child; being a Lecture delivered on November 1.3, 1999, to Teachers from the London County Council Schools. By Karl Pearson. Pp. 26+3 plates (London: Cambridge University Press, 1927.) 3s. net.

(2) Contraception (Birth Control), its Theory, History, and Practice: a Manual for the Medical and Legal Professions. By Dr. Marie Carmichael Stopes. New and enlarged edition. Pp. xxvi + 480 + 5 plates. (London: John Bale, Sons and Danielsson, Ltd., 1927.) 15s. net

THE two works which are the subjects of this review both arrive at the conclusion that birth-control is a necessity, but whereas Prof. Karl Pearson desires it in the interests of the future generation, Dr Marie Stopes demands it in order to relieve the over-harassed mother.

(1) Prof. Karl Pearson's pamphlet is a reprint of a lecture delivered to elementary school teachers; we congratulate him heartily on his descent from the clouds of the higher statistics, and his determination to talk plain common sense which every one can understand. He shows in the most convincing manner that certain repulsive deformities like 'lobster-claw,' and certain dangerous weaknesses like hæmophilia or bleeding, are handed on from

generation to generation, he says that in a primitive state of society individuals afflicted with these taints would never have been allowed to survive, much less to marry. He points out that such weaklings are only preserved in the mawkish at measurements of sentimental sympathy which is developed in our civilisation, and that in the history of humanity advance has come not from the persistence of old civilisations, but from the irruption of virile races reared in 'a hard cradle' who had overwhelmed the effemmate civilisations which they encountered and appropriated as much of their culture as they saw fit.

Prof. Pearson is less happy in his remarks on the relation of religion to eugenies It is true, as he says, that the biological function of religion is to assure the solidarity of the tribe, and that the powerful taboos of primitive religion concerned themselves largely with the three great events in human life-birth, marriage, and death. thinks, with the late Sir Francis Galton, that eugenic principles will never prevail until they have behind them the driving force of religious sentiment, he calls therefore for a modification of religious sanctions which will make the marriage of those marred with physical and mental defect to be as great an offence against religion as murder and adultery, unless those so married consent to have no children Prof Pearson, however, forgets that primitive man obeyed the taboos not so much from r' fear of his fellow-tribesmen as from dread of the supernatural intervention of the higher powers in whom he fervently believed From Prof Pearson's contemptuous remarks about God it is clear that he does not share this belief, and without it religious sentiments are impossible. The idealistic and highminded may have regard to the interests of the race when their individual interests collide with them, though personally we doubt it, but the hope that the lazy and self-indulgent will pay any attention to the interests of posterity, if to use an American's phrase 'they can get away with it,' is idle. Least of all will they be deterred by a make-believe religious sentiment if they have ceased to believe m God

While in general we agree with Prof. Pearson's views, certain difficulties occur to us. Hæmophiha, for example, manifests itself in men but is transmitted through women. Now could we seriously expect a healthy, vigorous young woman to abstain from marriage with an equally healthy young man because her great-great-grandfather had suffered from hæmophiha and she might be a transmitter of the taint? Again, whilst we cordially

would be a great gain, these defectives ate at the worst a small percentage of the dation: the really great menace comes from an over-propagation of the idle and thriftless, who would not be classed as either physically or mentally defective. To support the children of this class the thrifty are taxed to the bone. The birth endowment for which Prof. Pearson calls is already in full action in this case; it seems to us that the compulsory sterilisation of the thriftless when they bring into the world more children than they can support, would do more for society than the segregation of defectives

(27 \(\beta\): Marie Stopes's book consists in a history of the various varieties of birth-control and especially of contraception. She recalls to our memory the fact emphasised by Prof. Carr-Saunders that birth-control in the form of infanticide and abortion has been practised by all races of men since time immemorial, and that even drugs which prevented conception were known in antiquity useful service in demolishing the legend, sedulously propagated by a certain coterie, that the legality of birth-control was established by Bradlaugh's fight for it She shows convincingly that the very pamphlet in connexion with which Bradlaugh was prosecuted had been sold for years without let or hmdrance, and that the police only interfered when the publisher added to it several indecent illustrations. Bradlaugh's intervention, so far from helping the cause of birth-control, really hindered it, since it caused it to be associated in the minds of the public with his unpopular atheistic views

Dr. Stopes seems to think that Carr-Saunders has disposed of the arguments of Malthus. Never was there a greater illusion—Malthus's main position stands to-day as an impregnable rock, and has indeed since Darwin's time become a commonplace of biology. The fact that Malthus did not foresee the expansion of our food-supply by the exploitation of then undiscovered agricultural areas is irrelevant, this merely postpones for a limited time the advent of the crisis which he predicted and which has already arrived in overpopulated countries like India and China.

Dr. Stopes gives an elaborated and detailed account of the physiology of sexual intercourse and of the relation to it of the various methods of birth-control now in use, giving of course prominence to that which she recommends. It would be entirely out of place to discuss these methods in the columns of NATURE, but Dr. Stopes raises several points of considerable physiological interest which may be

She maintains that the male mentioned here sexual discharge, in addition to the fertilising spermatozoa, contains a hormone the absorption of which is most beneficial to a woman's health. A priori this seems not unlikely, but it is an exceedingly difficult matter to prove, and when one views the healthy, vigorous unmarried women around one, it is rather difficult to believe Then Dr. Stopes stresses the fact that in the emotions accompanying contion, there is a female crisis which is reached later than the male crisis, and that when this is not attained the woman is left in an unsatisfied and irritated condition which, often repeated, leads to marital unhappiness and makes a shipwreck of the marriage.

Whilst the normal reader must experience a shock in finding these intimate matters discussed m such detail and in such plam language by a woman, and whilst the reviewer must admit that he sympathises with this feeling of shock, there are certain considerations which give him pause before he indulges in condemnation of the author Some years ago, in the common-room of a certain college, the reviewer happened to be the only biologist present when one of Dr. Stopes's books ("Married Love ") was discussed. He was immediately challenged to give his opinion on it, and he replied that while it seemed to him that this book could only have been written by a person entirely devoid of reticence, yet that it would do good in giving information about physiological matters such as the female crisis, which could be obtained nowhere else. To his amazement and stupefaction, two of his questioners, both scientific men and both married, confessed an utter ignorance of the very existence of a female crisis!

Dr. Stopes gives figures to show that the chances of survival of the children decrease with the rapidity of succession of pregnancies, and the cases selected from her records give ample evidence of the fearful wreckage of women's health which results from overbearing. Part of the book is given up to incisive replies to the various attacks which have been made on Dr. Stopes, and the reviewer must confess that in these replies she has his entire sympathy. When the urgent necessity of birth-control by some method is becoming evident not only to biologists but also to economists and even to politicians, it can only be described as hypocrisy on the part of the Church to condemn practicable methods and recommend abstinence and selfcontrol to the ordinary man in the street who lives with his family in cramped quarters. That there is inherent wickedness in the sexual process itself is a superstition worthy only of the darkest Middle Ages and reflecting an outlook on the world which no rational man can now uphold

In conclusion, we can only say that Dr Stopes's book is a compendium of most valuable theoretical and practical information on the all-important subject of birth-control E W. MacBride

## A Treasury of Learning.

Introduction to the History of Science By George Sarton Vol. 1 From Homer to Omar Khayyam (Published for the Carnegie Institution of Washington Publication No. 376) Pp xi +839 (Baltimore, Md Williams and Wilkins Co, 1927.) 10 dollars.

CONFRONTED with this volume, for which the only adjective at all appropriate is 'colossal,' one can appreciate the feelings of the rustics before Goldsmith's schoolmaster:

"And still they gaz'd, and still the wonder grew That one small head could carry all he knew."

Dr. Sarton's amazing erudition, equalled only by his energy, is fittingly accompanied by a breadth of sympathy and interests due in part to his personal history, of which he gives some details A Belgian by birth, of mixed French and Flemish ancestry, he married an Englishwoman and has since become American by adoption. His work on the history of science was begun near Ghent, but on the outbreak of war in 1914 he was forced to abandon his home and to bury all his manuscripts in the garden. Fortunately, the invader overlooked this buried treasure, and the papers were safely recovered in 1919 mind's eye, the vision of Dr. Sarton digging up buried knowledge from its hiding-place is symbolic, for he has devoted his whole life to this very task, and the first-fruits of his labours are now presented to us.

'First-fruits' may seem a particularly mept word to describe the book now before us, which many a scholar would be more than content to have to his credit as the sole product of his working years. Yet to its author it is but the foundation-stone of an imposing building the plan of which he sketches as follows There are to be altogether three series of books. The first series will consist of a purely chronological survey of the history of science (a term which, as interpreted by Dr. Sarton, has a wide significance), from the earliest times to the present day, in units of half a century. The present volume is the first of this series, and

seven or eight more of the same size re The second series will give surveys of types of civilisation and will run to about The third series will deal with volumes evolution of special sciences, in eight or pine volumes, namely, (1) logic and mathematics; (2) physical sciences, (3) biological sciences; (4) sciences of the earth, (5) anthropological and historical sciences, (6) medical sciences; (7) edicational sciences; (8) philosophy, and (9) general index Of this vast field, Dr. Sarton hopes himself to cover the first series down through the eighteenth century, parts of the second series dealing with Semitic and Far Eastern civilisations, and the second volume of the third series. If this ambitions, programme is realised, as every one will hope it may be, Dr. Mellor will have to look to his laurels! Not content with his linguistic attainments, Dr Sarton light-heartedly undertook, as a mere trifle in passing, the study of Arabic under Prof J R. Jewett and Dr. D. B Macdonald "there were giants in the earth in those days"

The chronological survey in this introductor volume begins with the dawn of Greek and Hebre knowledge in the ninth and eighth centuries BC and ends with the time of Omar Khayyam (second half of eleventh century A.D.). Each half-century from the fourth century B.C. onwards, is given a separate chapter and is christened with the name of its most representative man; thus 250-200 B.C. is called "The Time of Archimedes," while A D 800-850 bears the name of the mathematician Al-Khwārizmī. This simple device is remarkably efficient in helping the memory to assimilate the chronological sequence, and its adoption must be regarded as a stroke of genius. Especially for medieval times, our memory of dates is too often lamentably vague, and yet we must acquire an adequate sense of the succession of men and events if our mental pictures of the progress of science are to be accurate Dr. Sarton rightly insists upon the essential importance of strict chronology, so far as it can be ascertained, and has chosen his chapter titles for mnemonic purposes; "we should find it difficult," he justly says, "to remember that such or such a man flourished in the first half of the ninth century, and such or such another in the second half of the same century, but we can more easily recall that the former flourished at about the same time as Al-Khwārizmī, while the other will naturally cling in our memory to the personality of Al-Rāzī" It has seemed necessary to dwell upon this point, because a casual glance at the book might give the impression that it is

solely a work of reference, whereas in point of fact it contains much to be read and remembered

Each section is provided with a brief introduction or summary and a critical review of the relevant literature. The wealth of bibliographical detail is frankly stupendous, and in those sections which we have tested, very little of real importance has been omitted, though we noticed, for example, that H. Joachim's article on "Aristotle's Conception of Chemical Combination" was not mentioned in the list of authorities quoted in the paragraph on Aristotelian chemistry. Such occasional lapses are inevitable, and serve merely to throw into higher relief the sound and careful scholarship and painstaking industry which Dr Sarton has brought to bear upon his researches.

Of especial value are those sections devoted to Chinese science Hitherto, information respecting the scientific attainments of this people has been very difficult to collect, and even when collected its value and trustworthiness could not always be properly estimated. It is probable that a fuller knowledge of early Chinese work would cause us radically to modify some of our present opinions on the development of the sciences—particularly chemistry, as urged by Prof Partington-and a systematic survey of the subject is urgently required. Dr Sarton has provided an excellent starting-point in his collation and valuation of the critical literature available, and perhaps European or Oriental scholars may now be stimulated to undertake the necessary labour. It seems certain that such labour would be well repaid

Similar care has been bestowed upon the accounts of Muslim science, about which more is known, but of which there has been no comprehensive synthesis, most investigators having chosen particular topics for intensive study rather than a broad survey of all the various aspects. Dr. Sarton gives us the materials for such a survey and has pointed out the salient features. He has also taken pains to transliterate proper names accurately, a merit which is conspicuous by its absence in most histories of science, and the lack of which is not merely provoking but often seriously misleading.

The history of politics and that of art have been deliberately omitted on the ground that these subjects have already been adequately treated by others. Prehistoric times are also omitted for the present, since the rapid advance of archæology in recent years suggests that a short postponement may enable a much more satisfactory account to be given later.

Dr. Sarton expresses the hope that his sketch No. 3027, Vol. 120]

of the vast panorama of two thousand years of intellectual progress may help to guide the activity of a large number of scholars, by allowing them to undertake special investigations of particular topics without losing a sense of proportion and perspective. That his hope will be realised cannot be doubted, but we believe he will do more than prevent a loss of sense of perspective: he will convey it to those who have never possessed it and will render applicable to the history of science the words of the Pervigilium Veneris.

"Cras amet qui nunquam amavit; Quique amavit cras amet."

E J. HOLMYARD.

#### Modern Astronomy.

Astronomy A Revision of Young's Manual of Astronomy By Dr. Henry Norris Russell, Dr. Raymond Smith Dugan, and Dr. John Quincy Stewart Vol 1: The Solar System Pp xi+470+xxi Vol 2: Astrophysics and Stellar Astronomy. Pp xii+471-932+xxx. (Boston, New York, Chicago and London: Ginn and Co, 1926-1927) 2.48 dollars each vol.

THIS much-anticipated book is described as a revision of Young's "Manual of Astronomy," although, as stated in the preface, "the scope of the new work is somewhat more extensive than that of the former 'Manual,' and intermediate between this and the 'General Astronomy.'" The classical works of Young have long been the best volumes of their kind, except for the fact that they have been out-of-date on the physical side, and no more appropriate task could have been undertaken by their illustrious author's successors at Princeton than that which they have now brought to fulfil-So numerous and radical have been the ment advances of the last few decades that it has been found necessary practically to re-write the book, with an inevitable increase in length. The result, it may be said at once, is worthy of its prototype.

The two volumes deal respectively with "The Solar System" and "Astrophysics." This is probably the most satisfactory method of dividing the subject of astronomy for treatment as a whole, although the more minute classification given in the introduction to the book is inconsistent with it, in the sense that it is impossible to assign each of the six branches mentioned therein definitely to either the solar system or astrophysics. No method of dividing and subdividing astronomy is entirely satisfactory, for astronomy deals with a universe and not a multiverse, and the science has

progressed far enough for that fact to emerge and confound the would-be analyst. The present cleavage into two volumes cannot evade a number of phenomena—notably the sun, which it has to split into two parts. In the first volume the treatment of this body is mainly descriptive, it is chiefly an account of the sun as seen through the telescope. The second volume deals with the examination of the sun by the spectroscope and bolometer.

The contents of the first volume may be summarised as follows. After a brief introduction, astronomical systems of measurement are described, leading up to astronomical instruments and the problems of practical astronomy. The earth, moon, and sun are then discussed, with a separate chapter on eclipses. Between the consideration of "the planets in general" and the separate consideration of individual planets, a chapter of 49 pages, on celestial mechanics, is inter-The final chapter deals with comets and polated meteors and the origin of the solar system. Volume 2 begins with a chapter on the analysis of light, after which the solar spectrum and the sun's light and heat are dealt with. A chapter on atomic theory and astrophysics makes possible a general consideration of the stars and their various characteristics, including double and variable stars. Then follows a discussion of star clusters, the milky way, and the nebulæ, and the work concludes with two chapters on the constitution and evolution of the stars An appendix to each volume contains useful data, and each chapter includes a number of exercises for the student.

It is intended that the first volume shall be mastered before the second is approached—a plan which "has been adopted as a result of many years' experience in lecturing" It is with diffidence that one ventures to question the conclusion of the distinguished authors on this matter, but it should perhaps be said that the reviewer has found it more satisfactory to introduce all the principles and instruments of investigation before dealing with the bodies to which they are applied. In the treatment here adopted the spectroscope and its applications are not introduced until the second volume is reached, with the result that the accounts of several phenomena, begun in the first volume, have to be completed in the second. Perhaps no general rule can be laid down in the matter, and in any case both volumes are available together for the teacher to deal with as he pleases.

The treatment is comprehensive, clear, and, needless to say, accurate. The book is suitable for

the beginner with only an elementary knowledge of physics and mathematics, but includes, nevertheless, a little mathematical work (printed in smaller type) in the astrophysics volume which the elementary student is invited to omit use of the calculus has been completely avoided. The book appears to us to be undoubtedly the best text-book of general astronomy now available. The only criticism of a general character which we can make is that there are occasional lapses in English, of which two examples, taken from volume 1, will be sufficient. On p. 53 we read: "In the coelostat the plane of the mirror is parallel to that of the polar axis." The words "that of" should, obviously, be removed Again, on p. 164, a paragraph is headed "Method of Determining the Size of the Moon's Orbit, that is, its Distance and Parallax." The distance and parallax dealt with are, of course, the moon's, not those of its orbit. We have, however, noticed no serious ambiguity arising from this cause

The book is clearly printed and well and copiously illustrated, although the reproduction (Fig. 190) of Sir Norman Lockyer's flash spectrum, obtained in India in 1898, is very disappointing.

H. D.

## Our Bookshelf.

Pernicious Anæmia, Leucæmia, and Aplastic Anæmia: an Investigation from the Comparative Pathology and Embryological Point of View. By Dr. J. P. McGowan. Pp. vii + 116 + 5 plates. (London: H. K Lewis and Co., Ltd., 1926.) 7s. 6d. net.

Dr. McGowan's investigation of these blood diseases originated from a series of observations on leucosis in fowls and iron deficiency as it occurs in pigs. The similarity between the former condition and the pernicious anæmia-myelogenous leucæmia group of diseases in human beings was apparent, and it was considered that their common association with iron deficiency in morbid conditions of the hæmatopoietic system might shed light on some of the problems of human blood disease. Commencing with the demonstration of leucosis as a definite pathological syndrome with several different causal factors, it is postulated that the similar syndrome in human beings has likewise a fundamental pathogenesis. It is considered that this is a modified hyperplasia due to an irritative condition and ending in some cases in sclerosis or aplasia of the bone-marrow. In those cases of pernicious anæmia in which no definite irritative factor, such as tapeworm or specific poison, is recognised, it is suggested that there has been some general infection which has damaged the bone-marrow.

The association with iron deficiency is through

the metabolic function of the liver in preparing iron and fat for the production of erythrocytes. The aplastic form of anæmia has its cause in the failure of the poisoned liver to carry out this 'function, apart from the toxic changes in the bonemarrow. Iron deficiency is considered to be due to deficiency in milk of iron relative to protein or growth-stimulating substance and to the growth potential of the young animal.

The whole subject is presented with unusual lucidity, and Dr. McGowan's conclusions will be of considerable interest to students of pathology

and comparative medicine.

The Commerce of Agriculture · a Survey of Agricultural Resources By Prof F. A. Buechel (The Wiley Agricultural Series) Pp ix +439. (New York John Wiley and Sons, Inc; London: Chapman and Hall, Ltd., 1926.) 18s. 6d. net.

The framework of this book is ambitious. agricultural resources of every part of the globe are explored, with, in some cases, disappointing brevity. Under 'resources,' aspects are considered which do not, as a rule, find a place in agricultural text-books For example, there are sections on climate, soils, origin and development of trade, agricultural organisation, and so forth. The matter is so encyclopædic that a considered review is not possible here As a test we turned to the section on 'Rice,' and would query the accuracy of the statement that "rice is by far the most important crop" in India Again, under the heading of potato diseases it is disappointing to find that only two are mentioned, 'scab' and 'blight.' The botanical names should have been given, for, under the latter, two, 'early' blight and 'late' blight, are mentioned as if they were distinct diseases, whereas both, presumably, are Phytophthora infestans.

These criticisms should not, perhaps, detract from the real value of the book, which under one cover presents a really informative survey of world agriculture. We commend in particular the excellent statistical maps showing crop distribution in various countries, selected from the admirable

series published by the US. Government.

The Credibility of Herodotus' Account of Egypt in the Light of the Egyptian Monuments: being a Lecture delivered at the Fifty-fifth Congress of German Philologists and Schoolmasters at Erlangen. By Wilhelm Spiegelberg. With a few Additional Notes by the Translator, Aylward M. Blackman. Pp. iv +40+2 plates. (Oxford: Basil Blackwell, 1927.) 2s. 6d. net.

A TRANSLATION of Prof. Spiegelberg's lecture on the credibility of Herodotus as a recorder of Egyptian history will doubtless be welcome to many whose acquaintance with the language of the original is limited. Much of what he has to say is new, while his intimate acquaintance with the monuments has enabled him to give greater precision to views already put forward in general terms on the sources of the information recorded by the 'father of history.' His approach to the

problem is by way of two inquiries. First, what was the state of Egyptian civilisation at the time Herodotus visited the country? Secondly, in what circles of society did he move during his visit? His conclusion is that the intense preoccupation of the Egyptians in their own past had produced a number of popular actiological legends evoked by the monuments, and that these were related to Herodotus by interpreters and members of the inferior ranks of the priesthood. The application of this theory to the story of the escape of Sesostris from the fire over the bodies of his two sons is certainly ingenious and more than probably correct.

Wave Mechanics: an Introductory Sketch. By H. F. Biggs. Pp. 77. (London: Oxford University Press, 1927.) 4s. 6d net.

Mr Biggs has rendered a distinct service to physicists by preparing this short account of Schrodinger's theory. Beginning with the hypotheses of Louis de Broglie, out of which the subject has developed, he traces the evolution of the idea that wave-mechanics bears to classical mechanics the same relation as wave-optics bears to ray-optics, and obtains the partial differential equation for the  $\psi$ -waves, proceeding then to its applications in spectroscopy. The style is lively and readable, the points are well made, and altogether no better introduction to the latest phase of the quantum theory can be desired. We may perhaps offer two slight criticisms • the translation of Eigenwerte by " special values " seems particularly unfortunate for those who dislike "characteristic values" or 'autovalues," the term "double numbers" may be suggested: and the mathematical treatment of the hydrogen-atom problem is greatly simplified, as Prof. Eddington pointed out some time ago in a letter to NATURE, by referring to the known properties of the  $W_{k,m}$  functions.

Local Geology: a Guide to Sources of Information on the Geology of the British Isles. By Dr A. Morley Davies. Second edition. Pp 16. (London: Thomas Murby and Co., 1927.) 1s. net.

IT is a pleasure to be given a second opportunity of directing attention to Dr. Morley Davies' extremely useful little pamphlet, partly because it is intrinsically of great educational value, and partly because the call for a second edition indicates that it is adequately serving its purpose. Our splendid series of geological maps are not nearly so well known as they should be. Dr. Davies has done the Geological Survey of Great Britain a service as well as the general public by providing this simple and interesting guide. An appendix has now been added listing new maps and leading references. One sentence is worth quoting in the hope that the Geological Survey may be encouraged to remove what is a common source of annoyance in the north of England and south of Scotland: "Unfortunately, sheets 1, 2, and 11 cover very small portions of England and much larger portions of Scotland, but they treat Scotland as a terra incognita."

#### Letters to the Editor.

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## The "Palæolithic Implements" from Sligo.

HAVING regard to the apparent importance of the discovery recently announced in letters from Messrs. J. P. T. Burchell and J. Reid Moir (Nature, Aug 20 and Sept. 24, 1927), and to the publicity which the matter has received in the Press, we considered it advisable to examine the several localities indicated. This we have now done. We had no difficulty in identifying the various sites, although some inaccuracies in the descriptions suggest that these were written from memory, and not from adequate notes taken on the spot.

The western or seaward side of the promontory called Rosses Point, the site of Mr Burchell's "rock-shelter," has three projections of limestone jutting mto the sea, with areas of sand between. Mr. Burchell does not state on which of these projections his "rock-shelter" is situated, but says that it "has a south-westerly aspect." We found on the middle projection a small undercutting of the cliff, facing south-west, which might conceivably have been a fallen-in rock-shelter; it is about 100 yards to the south of the lighthouse. But in no other way does it correspond to Mr Burchell's description; there are no "fallen blocks" upon its floor. The only hollow which agrees with the description in this respect, and in dimensions, is on the southern projection; but it faces magnetic north. It is about 100 yards north of the ladies' bathing-place

Mr Burchell describes an "Early Neolithic Raised Beach," consisting of "powdered shells to a depth of one foot" as "covering what remains of the roof" of his rock-shelter. No such feature exists above the roof of either of the rock-hollows just referred to. Indeed, there is no Raised Beach of any date in the district. The only covering above both of the hollows is a layer of gravelly soil, formed by disintegration of the limestone in situ, mixed with windborne sand and occasional fragments of shells. These shells were doubtless carried up by gulls, as is still being done. They are of species now common in the bay (Mya arenaria, Solen siliqua, Ostrea edulis, Mactra solida). About twenty yards to the south of the hollow on the middle projection there is a flattened heap of fragmentary oyster-shells, possibly accumulated by human agency; these are within reach of high waves, and certainly do not form a "raised beach."

We could not detect any trace of the "boulderclay" in a hollow of which "the outer margin" of the "Raised Beach" is said to lie. Boulder-clay occurs on the northern end of the Rosses Point promontory, where, however, there are no "shelters"; and also on its southern shore, under the modern village.

The "large cave four feet high" on Coney Island lies underneath the lower of the twin beacons at the north corner of the island. We consider that its existence is clearly due to recent undermining of the massive limestone of the low cliff, by erosion of the softer underlying shales. The masonry foundation of an earlier beacon (not more than fifty years old) now overhangs the face of the cliff above the cave by about three feet, and the beacon has had to be

moved inland in consequence This shows that the process of erosion is still actively in progress

It is inconceivable that caves of this kind and in

It is inconceivable that caves of this kind and in such a situation could have persisted from Mousterian times. They are in an area that was severely glaciated by ice passing from the land out to sea. They pronouncedly jointed and bedded character of the rocks would in these circumstances give rise to excessive plucking, as is indeed evidenced by the sections below the houses of the village, where the thick masses of boulder-clay are crowded with large angular blocks of limestone. Any pre-glacial cave would thus have been obliterated. Moreover, there is abundant evidence, all along the coast, of rapid marine erosion; and any such "shelters" would have been washed away, even since Neolithic times. Similar hollows are still in process of formation indeed, it seemed to us doubtful whether the hollows under consideration were in existence at all a hundred years ago. Their floors are at such a level that they are uninhabitable, as the sea invades them at every at a higher level.

We see no reason to accept the statement that any of the countless stones littered upon the beach of Coney Island were "drifted out" of the cave. Among the mfinity of shapes which these stones present, there are some resembling choppers, scrapers, and other tools; but in no greater proportion than might be seen on any other linestone beach.

might be seen on any other limestone beach.

As to the "implements" described by Messis. Burchell and Moir, we offer the following observations. In the first place, "Mousterian implements are not, as a rule, "of impressive size." Moreover, we are at a loss to understand the meaning of the term "patination" as applied to limestone. Weathering produces a change of surface colour, but this is not putination.

Secondly, we find it impossible to understand why the hypothetical cave-dwellers made their implements of so unsatisfactory and unusual a material as linestone, when an inexhaustible supply of chert was available. Beds of chert, in many places up to six melies in thickness, form at least half of the bulk of the rocks about Rosses Point.

Thirdly, limestone, as is well known, and as we confirmed by experiments on the spot, does not break with a conchordal fracture.

Fourthly, although we found some stones which closely resembled in outline those illustrated by Mr. Burchell, careful search in all of the sites failed to reveal a single object which could be accepted as undoubtedly a human artefact of any kind whatsoever, or of any date. There was nothing in any of the sites but ordinary beach material, derived from the splintery rock of the neighbourhood.

At Ballyconnell we found two sites agreeing generally with Mr Burchell's description. In each of these the boulder-clay is excessively stony, containing hundreds of thousands of fragments of all shapes and sizes. These are broken with sharp angular fractures, especially in the lower part of the deposit: and it would not be difficult, if any one chose to spend a few hours on the unprofitable task, to collect a large number of fragments bearing a superficial resemblance to artificially formed implements. But having regard to the geological history of the area, and to the nature of the boulder-clay deposits themselves, we could not admit the possibility of any of the stones thus collected being artefacts.

In view of the serious nature of the claims made by Mr. Burchell, we feel that he should be called upon to substantiate them on the spot—preferably in the

presence of a competent jury of geologists and archæologists, selected by some neutral body. We feel also that Mr. Reid Moir should be requested to demonstrate to the same jury the possibility of manufacturing, from the material available at Rosses Point, Levallois scrapers (or any other sort of tool) by the complicated process which he describes.

Until these things have been done, we must express and maintain a complete disbelief in the authenticity

of this alleged discovery.

R. A. S. Macalister, J. Kaye Charlesworth, R. Lloyd Praeger A. W. Stelfox.

Dublin, Oct. 8.

I have to thank Mr Burchell for the generosity of his personal attitude towards the problem of the stone flakings that he has found at Rosses. I regret that I cannot accept his views, but as I am not acquainted with the site, I will refer only to the flakings themselves, judged on their own merts, which I have had good opportunities of examining.

It is not easy to describe differences of technique, nor the differences of intention, or the lack of any intention, that one senses behind the technique. It is largely the personal equation of judgment

At the moment, I will only say that I can see no suggestion of prehistoric technique in this collection of flakings, neither can I see any example of intentional secondary working. For myself, I can see no passable resemblance in any one of these flakings to any form of prehistoric implement, either palæolithic or neolithic S HAZZLEDINE WARREN

Sherwood, Loughton,

Essex.

# The Habits and Economic Importance of the Rough Whelk-Tingle (Murex erinaceus).

In 1925 I reported to an oyster company that "in 1924–25 the whelk-tingle (Ocinebra (Murex) erinacea) was very abundant and very destructive. In my experiment 'A,' fully half of the brood of 1924 were found bored by the whelk-tingle, and it was obvious that most of the young oysters had been attacked in the early summer of 1925, since many of those bored had put on new growth."

The results obtained in the experiment quoted may be taken as roughly representative of what had happened in the beds. In the following year, 1926, there were strong indications that quite 50 per cent. of a good spatfall on the beds had been eaten by the whelk-tingle. Murex is fought on the beds by the dredgermen bringing in—on extra payment—clumps of spawn, as well as the living adult animal, but the rate of destruction is probably much less than the rate of increase, so that the pest is growing worse. Relief from this pest cannot, therefore, be obtained economically by oyster-producers in the present state of knowledge.

It is common knowledge, however, among experienced practical oyster-producers that the whelk-tingle—and it is interesting to record *Echnus miliaris* also—is almost annihilated on beds after a severe winter. Unless, therefore, a new method of capturing Murex can be found, those oyster-producers who are handicapped by swarms of the pest, cannot expect abatement of the damage they cause until a very hard winter is experienced.

It occurred to me that if one knew enough about the habits of Murex, it would be possible to estimate its negative economic value as an oyster-destroyer, and offset this against the increased cost of production

of oysters, i e expenditure on extra wages, incurred in its destruction. For example, if individual Murex eat on the average one brood oyster a month during nine months of the year, and brood oysters are being bought at one penny each to lay on the beds, then the negative value of a Murex at the beginning of the period of nine months is about ninepence per annum. If Murex eats on the average more or less than one oyster brood per month, its negative value will be more or less than that amount. Suppose the negative value be sixpence per annum, then a man catching Murex at the rate of 40 per day, and being paid wages at the rate of 10s. per day, would be increasing the potential value of the stock of the beds In order to obtain some information on this subject, I carried out a few experiments this year to confirm a few previous ones made in 1922 The results of these experiments show that (a) of 15 oysters bored and eaten by Murex, the average time taken was about 57 days; (b) of 10 brood oysters bored, but not eaten, the average time taken was 41 days, but if one case of 13 days be omitted, the average time works out at about 31 days; (c) of 8 brood oysters nearly bored through and abandoned, the average time taken was about 4 5 days. These latter cases were probably special ones, where the shell was too thick or the borer became too weak to complete its work. These preliminary experiments show that Murex can attack and devour an oyster brood from 1 to 2 inches long—in 5 to 6 days. In the sea, or under better conditions than are possible in a laboratory removed from the oyster beds, this period will probably be reduced by reason of the better average condition of the borer, and the probability that once the oyster is bored, and—consequently—opened in the sea, other animals will share in the teast with the borer.

I have not had the opportunity of finding out how frequently one and the same Murex attacks and destroys oysters, and suggest that this problem, as well as that of finding a new and efficient and cheap method of capture on the beds, may be advocated as a special piece of economic research. If Dr. Dodgson, at the Government Fisheries Experimental Station at Conway, is eventually successful in producing oyster spat by the million, these will have to be put out in the sea to grow, and to withstand the attacks of natural enemies. Unless, therefore, beds can be found where Murex is a negligible factor, it may be anticipated that the spat produced under artificial conditions will be destroyed in greater numbers than natural spat. The problem is thus an important one in oyster culture.

In the experiments mentioned above it was found that Murex attacks small oysters at almost any place on either the flat or convex side; the borer may sit on the oyster, or it may successfully attack it by lying on its 'back' with the prey firmly held over it by means of the foot. (See the photo reproduced in Fig. 1, for which I am indebted to Mr. A. J. Smith.) Oysters are frequently attacked and abandoned; they may be abandoned for unknown reasons when partly bored, or after a complete boring if either a chamber, or a loose horny layer (see Orton and Amirthalingam, J.M.B.A., 14, 4; 1927), is encountered; or if the oyster is in a poor or pathological condition. There is probably a limit to the depth beyond which Murex of a given size cannot use its mechanical boring apparatus, but this limit is greater than 3 millimetres. The shells of oysters rarely attain a thickness of 3 millimetres at even the age of three or four years.

In 1922 Murex attacked brood oysters throughout the period of the experiments from the end of January to the middle of March; this year similar results were obtained from July to the middle of October,

the whole period of the observations.

Murex, however, like Purpura lapillus, feeds on barnacles as well as oysters, and some individuals in my experiments have preferred to attack and eat barnacles when there were oysters in the same dishes In this year's experiments it was found that Murex attacked *Balanus perforatus*, a large species of barnacle (see Fig. 1 on the right), Balanus crenatus, and another unidentified barnacle, either by boring a hole through the shell or directly through the operculum, and the time taken to destroy B. perforatus was similar to that spent on boring and eating oysters. The smaller balanids are eaten at a much quicker rate In the sea Murex probably eats all kinds of acorn barnacles Thus barnacles, when present in abundance on oysters, a condition so frequently deplored by oyster cultivators, protect the more valuable animal by offering

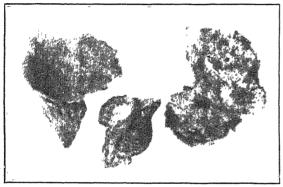


Fig. 1.—Two living Muiex boring oysters and one eating Balanus. The middle West Mersea Murex is laid on its 'hack' holding by its sucker-like toot and boning an oyster spat The left-hand Murex is also on its 'back' holding and boning an oyster brood, both are from West Mersea. The right-hand Murex, from the Fal estuary, is itself covered with small barnacles and is eating, after having bored, a Plymouth Balanus perforatus. (Photo of the living animals in sea-water by Mr A. J Smith.)

themselves as a first source of food to either Murex or Purpura lapillus, the smooth whelk-tingle. One individual of Purpura attacked and ate an oyster in my experiments, but this species clearly prefers barnacles, without confining itself, however, to either

oysters or barnacles.

Murex will also attack Crepidula, as I have found by experiment, but it is either unaware from strangeness of the value of Crepidula as food, or incapable of attacking it easily; a few bored shells of Crepidula have been picked up from oyster beds, but in these instances the borer may have been either Murex or Purpura. It might, however, be possible to introduce into the Thames Estuary oyster beds a natural borer enemy of Crepidula as a means of keeping down that pest, but it would be necessary first to discover whether that particular borer attacked oysters, i.e. O. edulis.

It is an interesting fact that Murex may return to complete its work of boring an oyster, time after time, even after it has been forcibly removed from its prey. In one case I removed an individual from its boring four times, and laid it on its 'back' each time not less than 1 cm. away from the borng, it returned to the same boring each time like a dog returning to a bone. In other cases individuals have returned to their boring after respectively two removals and one removal from both oysters and barnacles, while in some few instances the Murex has not returned after being removed. J. H. ORTON.

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No. 3027, Vol. 1201

The Manoilov and other 'Chemical Sex Reactions.'

SINCE 1924, Joyet-Lavergne, working with plants and Protozoa, has been developing the view that in general female sexual cells are more reducing than male as judged by their effects on the colours of dyes; recently 2 he considers that they contain more reduced glutathione because they give the colour reactions of this substance more strongly. In 1922, Manoilov 3 developed a 'test for sex' in plants by an elaborate treatment of dyes of the rosaniline series as a result of which the female side was made to display the deeper colour, that is, the reverse of the Jovet-Lavergne effect, Satina and Demerec 4 have confirmed and developed this test, applying it to animal tissues, and amongst others to the cladoceran Crustacea Moma and Daphnia <sup>5</sup> More recently, Falk and Lorberblatt,6 working again with animals (manimalian ovary and testis), have demonstrated that the test depends on an oxidation phenomenon, the more complicated Manoilov technique being replaceable by the oxidation of colourless p-leucaniline in the presence of sufficient ferric chloride by which the temale side again produces the deeper colour of p-rosamline and is therefore apparently more oxidising than the male, Falk and Lorberblatt also report an interesting parallelism' in that the extract of testis which they used was found to have considerable reducing power as shown by Tunnicliffe's method of estimating glutathione? whilst the ovarian extract had none, and Sir Frederick Hopkins tells me that this disparity has been long familiar to him.

In 1923 (unpublished work) I myself found that the shore-crab Carcinus when inflicted with the parasite Sacculina (in which case the males are apt to assume a feminine appearance) suffered a diminution of sulphur and the nitroprusside reaction distinetive of glutathione, and have since demonstrated the same phenomenon in several ways. Although 1 have never found clear evidence of a normal sexual difference in the content of glutathione in Carcinus, it has become apparent that the assumption of feminine characters by the male goes hand-in-hand with the decrease of its nitroprusside reaction and is therefore perhaps associated with the removal of a substance of a disulphide type which may be of considerable importance in tissue exidations. On applying the Manoulov, and the Falk and Lorberblatt, and other tests of the same nature described below, I find that parasitised male crabs invariably display a relatively female reaction whether their external morphology be modified or not; at the same time it was evident from the first that glutathione is not solely responsible for the reactions, because they can be procured from the blood in which the nitroprusside test fails to indicate the presence of reduced gluta-

thione.

The dye tests for sex which I have employed on various crustacea, Cancer and Carcinus (Brachyura), Homarus, Pandalus 2 spp., and Crangon (Macrura), Gammarus (Amphipoda) in various physiological states, sexual immaturity, parasitism (by Sacculina, Portunion, or Phryxus), and hunger, as well as on the diœcious plant Mercurialis annua, may be summarised as follows:

(1) The direct action of an extract on the dye (p-rosaniline). The female side is typically the more reducing, that is, the Joyet-Lavergne effect

(2) Oxidation of the reduced dye (p - leucaniline)

P. Joyet-Lavergne, CR Ac. Sci. Paris, 179, 1212; 1924.
 P. Joyet-Lavergne, CR Ac. Sci. Paris, 184, 1088; 1927.
 E. O. Manoilov, Bull Appl Bot Plant-Breeding, 13 (2), 503; 1922.
 S. Satina and M. Demerec, Sevence (New York), 1925, p. 225.
 S. Satina, Proc. Soc. Exp. Brol. Med., 22, 466, 1925.
 K. G. Falk and I. Lorberblatt, Brit. Jour. Exp. Biol., 4, 305, 1927.
 H. E. Tunnichiffe, Bioch. J., 19, 194; 1925.

by a minimal quantity of oxidising agent (ferric chloride or hydrogen peroxide) in the presence of tissue extracts. The extracts are inhibitory to the oxidation, apparently through combining with the oxidising agent, and female extracts are typically more effective than male, i.e. the Joyet-Lavergne effect produced with the leuco-dye. This test is more obvious than the Joyet-Lavergne and more constant than the remainder.

(3) Oxidation of p-leucanilme by excess of oxidising agent in the presence of extracts. The inhibitory effect observed under (2) is now destroyed, and the female side usually presents the deeper colour of dye. Evidently there are at least two factors which set up the oxidation conditions of the extracts, and a reducing factor which is present in greater force in females is destroyed by the oxidising agent

This is the Falk and Lorberblatt test (4) Destruction of p-rosaniline by potassium permanganate in the presence of tissue extracts. Potassium permanganate enters into combination with the extractives, quantitatively more so in female extracts which may therefore be considered the more reducing, the remainder is free to destroy the dye, and does so more rapidly in the case of males probably because they remove less permanganate. It is necessary to destroy the excess of permanganate by introducing a reducing agent, sodium thiosulphate or allyl thiocarbamide (thiosinamine)—but these apparently do not themselves decolorise such dye as may be unacted upon, except on very long standing or heating.

This is the Manoilov test; it is, in general, the most brilliant of the series.

(5) Schiff's rosaniline and sulphur dioxide test for aldehydes. Minute quantities of aldehydes (which restore the colour to this colourless compound) are very rarely present in fresh extracts, and then usually in males. If the solution be heated, the colourless compound dissociates and the full colour of the dye appears, to disappear again by recombination on cooling if the whole of the sulphur-dioxide be not boiled away; in the presence of tissue extracts the same phenomenon takes place, but (typically) on the male side the colourless compound is reformed much more slowly and less readily, which may possibly indicate that a factor which is capable of combining with and so removing sulphur-dioxide is more predominant in the male sex.

The tests may be applied either to aqueous (trichloracetic acid) or alcoholic extracts, but with the exception of No. 5 they are more successful when the reaction is strongly acid; I have failed to confirm Falk and Lorberblatt's observation that the presence of protein greatly enhances the disparity between the sexes, at least in trichloracetic acid extracts. Alcoholic extracts still exhibit differences after keeping for eighteen months, but dried tissues do not keep well.

It must be clearly understood that the tests are so delicate that some noticeable difference between two extracts is almost always observed, and that equally differences can often be discovered between two samples of the same extract as a result of faults in technique; moreover, biological conditions such as nutrition and maturity themselves produce profound effects and may be compared by these tests one with another, so that the distinction between a pair of extracts which differ only in sex is occasionally not at all obvious and still more frequently is 'reversed.'

I cannot subscribe to the view that these methods are 'tests for sex'—they are tests for certain oxidising or reducing properties in the setting up of

which more than one chemical factor plays a part, although they are undoubtedly closely associated with sex and also with other biological conditions.

MICHAEL PERKINS.

School of Biochemistry, Cambridge, Oct. 4.

#### Metallurgical Photomicrographic Apparatus.

The article on Metallurgical Photomicrographic Apparatus which appeared in Nature of Oct 8 can scarcely be considered satisfactory to those who desire to know the essential requisites of such an apparatus.

While certain engineering details are minutely discussed, scarcely any attention is paid to the essential requirements of such instruments, namely, the quality of the optical train and the methods of illumination

In photographing the extremely fine structure of metals, methods of illumination have been recently introduced which require adjustments on the apparatus which are not always provided. The method employed by Mr. Harold Wrighton in revealing structure of the order of 140,000 lines to the inch, and the new method of illumination devised by Prof. Carl Benedicks, are examples, and certain of the British instruments referred to are better equipped with these adjustments and are to be preferred.

With regard to the mechanical points which are discussed, the author, discussing the form of the optical bench, states that with the elongated triangular prism "freedom of movement and accuracy of adjustment might be obtained," and then makes the very definite statement that "it is impossible to machine the surfaces with the desired degree of accuracy to avoid shake." This is not the case if the triangular bar is machined with ordinary engineering accuracy, and the saddles bear on suitable surfaces unless the clamp is badly designed. The lathe bed type of a 'V' and a flat is an equally good design if the clamp is properly applied, as is also the parallel bar when properly constructed.

The geometric design depends for its accuracy on the accuracy of the bar, but the principle is not preserved when the apparatus has to be clamped securely in position. It must also be borne in mind that the design should be such that the apparatus can withstand wear, and to secure this sufficiently large bearing surfaces must be provided. The substitution of surfaces for points in a geometric design practically cuts out the geometric principle.

With regard to the focusing adjustments, it is difficult to see a convenient design in which both of the two focusing adjustments can be made without an overhanging weight, and as the coarse adjustment can be clamped and the fine adjustment cannot, it is much more desirable that any overhanging weight should be avoided on the fine adjustment. In a well-made fitting it does not cause any noticeable sag, but it has a marked tendency to cause 'sticking' in a fine adjustment, due to the lubricant being squeezed out from certain portions of the slide, causing metal to metal contact.

After all, there are various ways of providing convenient and efficient movements and adjustments for employing the optical equipment, all of which if properly made are satisfactory in use.

CONRAD BECK.

#### 69 Mortimer Street, W.1.

It is, of course, well known that for satisfactory work in any branch of microscopy, excellence of the optical parts of the apparatus is a prime essential.

In the article referred to, however, it was intended, as was suggested near the beginning of the article, to discuss only the mechanical construction of the various Any detailed reference to the method ınstruments of illumination, which is undoubtedly an item of considerable importance in metallurgical microscopy, was also thereby excluded When referring to items to which the user might attach importance because they suited his particular method of working, the writer had in mind the various methods of illumination employed, including the universal vertical illuminator fitted to the Beck instrument, which permits of the use of various types of transparent and of opaque reflectors which are easily interchangeable and easily adjustable in every required direction. Reference was also made in the article to the wide range of adjustment of the elements of the illuminating system provided by the British instruments These adjustments facilitate the use of the methods of illumination mentioned by Mi. Beck, but, as was suggested, the method of obtaining the adjustments might be improved.

In the production by ordinary engineering methods of the optical bench of the elongated triangular prism type, a certain manufacturing tolerance is necessary on the angle of the prism A manufacturing tolerance is necessary also on the angle of the saddle. If shake is to be avoided, no such tolerance can be permitted on either of these components. The geometrically mounted saddle will fit the triangular prism at any part of its length without shake, even though a reasonably large manufacturing tolerance has been allowed in the angle of the prism. When the saddle is in use, the forces brought to bear on it are not great; the relative movement of the saddle and the prism is not great; and the wear is thus not severe of the contact surfaces need therefore not be at all large. A properly designed clamp for the saddle should produce a pressure uniformly distributed amongst the five points. The only result of this departure from the geometric principle is to set up strains in the saddle. For effective clamping these strains need not be great, and the ordinary saddle is sufficiently robust to withstand them without perceptible deformation.

With regard to the focussing adjustments, it may be pointed out that the stage is subjected to varying loads. Frequently, fairly heavy objects are placed on it. These loads are effective on an overhanging stage whether the coarse adjustment is clamped or not.

There are, certainly, various ways in which the necessary movements and adjustments of the several parts of the photomicrographic apparatus may be obtained. The method selected should be such as is likely to be most efficient in use, and the design such as to be capable of being satisfactorily made at a reasonable cost. THE WRITER OF THE ARTICLE.

#### Science and Philosophy.

PERMIT me two comments on the references to my Huxley Lecture in the leading article in NATURE of Oct. 22.

In my judgment the writer put the cart before the horse when he suggested that philosophy had been changing the "fundamental conceptions of science." By the ordinary methods of science, prodigious advances in knowledge have recently been made, especially in mathematics and physics, and it is philosophy that is engaged in trying, in her usual

way, to bring herself up-to-date.

The writer refers to an "emergent theory" as if it had been an important principle, by overlooking which my polemic against vitalism had missed its mark." He may not agree with me, but so far from overlooking that odd theory, I described its origin

and explained how in my opinion it was a conspicuous example of the interpolation of an imaginary principle in an unfinished scientific story

P CHALMERS MITCHELL.

My intention was not to exalt philosophy at the expense of science, but to plead for co-operation between the two I cannot agree with Dr. Mitchell that the recent great advances in mathematics and physics have come about solely through the ordinary methods of science. Equally important has been the critical investigation of the fundamental concepts, for example, of time and space, which has gone on side by side with the discovery of new facts. Such criticism of concepts is generally regarded as a main function of philosophy, and if it be carried out—as it should be—by the scientific worker limiself, it remains none the less philosophy. In the sphere of biology we urgently need, it seems to me, this same combination of observation, experiment, and the critical study of fundamental conceptions

I have not accused Dr. Mitchell of overlooking the theory of emergence, and I even agree with him that in some of its forms it is regrettably vague. My point was rather that he appears to treat all forms of non-mechanistic doctrine as if they were based upon dualistic vitalism. This is obviously not true, for example, of Dr J. S. Haldane's views, or of Prof. A. N. Whitehead's 'organic' theory of nature.

The Writer of the Article.

#### An Aspect of the Biochemistry of Sugars.

In reply to Mr. Levene's letter in NATURE of Oct.

29, I would direct attention to the following points:
(1) Even if the hypothesis of inversion in the hydrolysis of sugar phosphates in Nature is correct, it may well be difficult to find the conditions for the mutation of the process in the laboratory. Mr. Levene has recently contributed a striking example in which inversion occurs with one reagent but not with another.

(2) The behaviour of glucose-3-phosphoric acid (or is it allose-3-phosphoric acid?) is highly interesting and important, but the glucose-galactose change involves position-4, where the stereochemical con-ditions are different. We know many cases—some are in the camphor group—in which direct replacement occurs as the result of steric influences, although analogies indicate that inversion should be regarded as the normal event in these reactions.

(3) The evidence that the pentose-phosphoric acid from mosic acid (Levene and Jacobs, 1911) is d-ribose-5-phosphoric acid is inconclusive, because a  $\delta$ -xylonolactone-phosphoric acid might be stable in acid solution at 40°. Admittedly the evidence favours the view of Levene and Jacobs, but it needs to be supplemented by methylation methods.

(4) Assuming that the pentose-phosphoric acid is d-ribose-5-phosphoric acid, that does not dispose of the main thesis, for the possibility exists that, in the original nucleic acid, the phosphoric acid is attached to the sugar molecule at more than one point (compare Thannhauser). Moreover, the migration of the phosphoric acid residue from one position to another in the chain is a possibility that must be kept in mind.

In short, the subject bristles with so many theoretical and experimental difficulties that it is doubtful whether a full discussion is possible at the present time.

Finally, my suggestions were not put forward as firm conclusions; I thought it worth while to advance them in order to indicate what seemed to be a useful working hypothesis. R. ROBINSON.

Sept. 29.

## Study and Research in Physics.1 By Sir Ernest Rutherford, OM, PRS

T is little more than fifty years since special laboratories began to be built, generally on a small and modest scale, for study and research in experimental physics and for the practical instruction of students. During this period, physics in Bristol has been represented by three professors, first for a short time, by the late Prof. Sylvanus Thompson, whose contributions to science will long be remembered, then by Prof. Chattock, who is held in high esteem by all his students for the efficiency and inspiration of his teaching. On his retirement he was succeeded by his pupil, Prof. Tyndall, and I am sure that it is not entirely an accident that this splendid laboratory, which we open officially to-day, had its inception and completion during his tenure of

I have always felt a certain bond of union with the University of Bristol, partly because your Council has thought fit to select as your teachers some of my friends and colleagues of other days, and partly also because I have always had a special interest in certain lines of research that have been carried on in the Physics Department. I refer to the investigations made here on the passage of electricity through gases, with special reference to the nature and life history of the charged ions which transport the electric current.

In my youthful days, when I was working as a research student in the Cavendish Laboratory in Cambridge, one of my first essays in investigation, under the guidance of Sir J. J. Thomson, was a study of the way in which a current passes through a gas which is made temporarily conducting by the action of X-rays. It was found that this weak conductivity could be ascribed to the production in the electrically neutral gas of positively and negatively charged carriers, or ions, as they were termed, which moved in opposite directions in an electric field. Information on the nature of these ions was obtained by observing the average speed of these ions when acted on by an electric field.

Although my work in later years has been in other directions, I have always retained a lively interest in this subject, and I well remember my excitement and pleasure when I read in the Philosophical Magazine for 1899 a paper by Prof. Chattock giving an account of an ingenious and powerful method for studying the mechanism of the discharge from electrified points, which is always accompanied by the long-known phenomenon of the electric wind. He was able to show definitely for the first time that the discharge was carried by a stream of charged ions, identical in character with the ions produced in the same gas by the action of X-rays. These experiments not only disclosed the mechanism of the simplest form of electric discharge, but also showed us in a convincing way that the nature of the ions

¹ Address delivered on Oct 21 in opening the Henry Herbert Wills Physics Laboratory, University of Bristol

was the same, whatever the process causing the ionisation

If time permitted, I should have liked to direct your attention to the extraordinarily interesting and varied phenomena which underlie the discharge of an electroscope by the action of X-rays or radium rays. Since 1896 this subject has been investigated by a large number of workers in all parts of the world, and no one has contributed more to our knowledge in the early days than my old friend, Prof. Langevin, whom we welcome as our guest to-day I must also particularly mention the researches in recent years on the lifehistory of an ion, the avidity with which it seizes on the molecules of water added to a dry gas, and the still greater avidity for the heavy molecules of alcohol and the consequent sluggish movements of the loaded ion. On this aspect of the almost human behaviour of the gaseous 10n, the researches of Prof Tyndall and his students have given us most valuable information

At first sight, it might well be thought that a study of the mechanism of the discharge of a gold-leaf electroscope under the influence of ionising radiations, however interesting it might prove to the scientific investigator, could be of little importance to the advance of science as a whole and of no obvious practical application. I have, however, taken this example of pure scientific research to illustrate the remarkable consequences that may sometimes follow the detailed study of an apparently trivial and smallscale phenomenon, made with no other object than to understand the processes of Nature, and I am sure in most cases with little idea of the important results that were ultimately to accrue both to science and industry

In the first place, the ionisation of a gas by radium and X-rays gave into our hands a weapon of great power and range for studying quantitatively the nature of X-rays and the rays from radioactive bodies. This has been largely mstrumental in unravelling the wonderful sequence of transformations that occur in radioactive matter, and has led to the discovery of more than thirty new unstable elements. In the second place, the information obtained of the mechanism of the passage of a current under the simplest condition could be at once applied to more complicated forms of electric discharge. It was soon recognised that the beautiful and varied phenomena which are observed when an electric discharge passes through a gas at low pressure was a consequence of the ionisation of the gas by the strong electric fields, similar, but more complicated than the discharge from a needle point. One of the first results of this study was the discovery of the electron, that mobile entity which we now know is one of the ultimate units in the structure of all atoms. Nor must we omit to mention the remarkable consequences that have followed the detailed analysis of the positively charged ions or positive rays that are always present in the discharge In the hands of Sir J J Thomson and Dr Aston, this has given us a method of precision for studying the isotopic constitution of the elements and for measuring the relative weights of the individual atoms with a certainty and an accuracy that would have appeared quite impossible a few years ago

It would take me too long to attempt to enumerate to you the great additions to knowledge that have been gained by a study of the effects of swiftly moving electrons and ions produced in a vacuum tube in exciting radiations visible and Indeed, it is true to say that a large part of the scientific advance in physics in the last thirty years may be traced as an almost direct consequence of the observations on the ionisation of a gas by X-rays I must, however, refer m passing to the great importance to science and industry of the emission of electrons from glowing bodies—a type of unipolar ionisation—that has resulted in the development of electric oscillators for radio-telegraphy of wonderful power and flexibility, and receivers for magnifying weak currents which have rendered possible the remarkable advances in wireless and broadcasting in recent years. In another direction, too, the effect of light in causing the emission of electrons from bodies—the so-called photo-electric effect—is the foundation of methods for transmitting pictures to a distance, and no doubt before long will give us television on a practical scale.

I hope I have made clear to you by this example the importance of encouraging in our laboratories fundamental research quite apart from any question of their possible application to practical ends. We live in an age when not only do many of the great industries, but also the Government, recognise the importance of the application of scientific methods for the rapid development of industry. Fortunately in Great Britain the Department of Scientific and Industrial Research is alive to the importance of fundamental research in our university laboratories, and by grants and other ways encourages the training of promising students in research method. It also in some cases assists and I hope will long continue to assist—some of our university laboratories in prosecuting important fundamental researches which are on too costly a scale to be undertaken without financial strain on the slender resources of our universities and other scientific institutions.

Since the War there has been a notable increase in the number of scientific men who are engaged either in fundamental research or in applied research with special reference to industrial problems. The question thus naturally arises as to the nature of the research work that should be carried out in a laboratory like this. Should the spare time of its teachers and research students be devoted to investigations on the fundamental problems of physics, quite apart from any question of immediate practical bearing, or to researches of a character likely to be useful in industry? This is an important question, but I should unhesitatingly say that our pure science laboratories should in the main

be set aside for fundamental research. from the interest and importance of adding to our knowledge of the processes of Nature, experience has shown that discoveries of the greatest significance to mankind, whether in the practical or intellectual sphere, are generally the outcome of fundamental research undertaken purely with the aim of adding to knowledge Industrial research should be undertaken by manufacturers or the Government in special laboratories where the research workers can come into close contact with manufacturing conditions This does not exclude the desirability of occasionally conducting applied researches in university laboratories, especially where one or more of the staff may have a special knowledge of the problems involved In general, however, I should view as an unmitigated disaster the utilisation of our university laboratories mainly

for research bearing on industry

When I look back over the thirty or more years of my connexion with research, I am conscious that I have always been looking for a breathingspace when, for a few years, no advances of consequence would be made; when I should gain an opportunity for studying in more detail, at my leisure, the ground already won. Alas, that breathing-space has never come, and I am sure will never come in my time It seems to me that the remarkable period of advance in physics, which began thirty years ago with the discovery of X-rays, shows no sign of retardation but rather of an everincreasing acceleration. It is becoming more and more difficult for the scientific man to keep in close touch with the advances in even a relatively small branch of his main subject, much less to read more than a fraction of the papers that are published in an ever-increasing stream.

This is especially the case at the present moment, when there is not only a rapid advance in experimental knowledge and technique but great activity in theoretical physics. The advent of the new or wave mechanics, with special reference to atomic problems, which promises to give an entirely new orientation to our ideas of the relation between radiation and matter, has much increased the difficulty, for the scientific man has to learn a new mathematical alphabet and language to keep 11. touch with this remarkable development, for which we owe so much to our visitor, Prof. Born of

Gottingen

While this difficulty is common to all scientific workers in a rapidly advancing subject, it is especially felt in comparatively small and isolated institutions in this country and still more in our distant Dominions. There arises, in many cases, a hopeless feeling that it is impossible to keep abreast with the flood of new scientific results and ideas, or to distinguish the wheat from the chaff. This reacts on the energy and enthusiasm of the scientific worker and diminishes the efficiency of his teaching and research.

This real danger can in part be surmounted by the co-operation and goodwill of our university authorities. If the scientific man is to maintain his intellectual activity and enthusiasm, it is in most cases important that he should be given leave of absence at regular intervals, and encouraged to visit other scientific centres, whether at home or abroad, and to get into personal contact with the workers in his special field. The value of such 'refresher' intervals is difficult to exaggerate, whether to the individual or the institution which he serves. I am sure that there are few scientific men that would not benefit by such opportunities.

At no time in the history of physics has there been a closer co-operation and sympathy between the two great branches of physics, the experimental and theoretical. With the ever-growing complexity of experimentation and technique, it is rare in these days that a scientific man can claim to be proficient in both of these branches. There has thus arisen the need that these complementary divisions should be adequately represented in a Department of Physics. I am very glad to see that this has been recognised in your University

by the appointment of Prof. Lennard-Jones as professor of theoretical physics. In addition, the institution of research fellowships to attract to the laboratory young men who have shown marked ability for research is a step in the right direction, and I hope that it will be possible in the near future to add to their number. Under such excellent conditions we may confidently anticipate that this laboratory will fulfil the wishes of the donor by developing into one of our most important centres of training and research.

The University owes much to the public spirit shown by the city of Bristol and to the wise generosity of its citizens. I am sure that all scientific men are grateful to the University and to the donor, Mr Henry Herbert Wills, whose generous benefactions have made possible the erection and endowment of this splendid laboratory dedicated to the pursuit of scientific

knowledge

## Marcelin Berthelot.1

By Prof Henry E. Armstrong, F.R S.

THE highest testimony we can give to the genius of a departed colleague is to study his work and its bearings, as in such exercise we are bound to find food for thought and gather inspiration for the future. As one of the older chemists, I would fam bear such slight witness as I may to the effect and value of Berthelot's achievements, being the more inclined to this task from having noticed, in the younger generation, a strange lack of interest in the pioneers who laid the foundations of the science they would master, now so mighty a structure—even a failure to understand the language these pioneers used. Continuity with the past is desirable, if only in order that we may understand the mental attitude of inquirers at the time they undertook their labours and be in a position to evaluate the mental development of their ideas.

Berthelot himself, who seems to have been extremely well read even at an early age, through his studies of the alchemists endeavoured to shed light upon the beginnings of chemistry and has thereby made clear the extraordinary difficulty Few to-day can appreciate his own of the task rigid attitude towards atomic weights—how it was # that he wrote C = 6 and O = 8 almost up to the last. If his intimate story could be written, it would probably be one of a mind ever striving to be scientific, yet held in the thrall of that superhuman force we term conservatism. the force by which our human society is held together and boundthe instruct of the herd-through the exercise of which we alone survive. On the other hand, it also separates us and especially from the pastas each new faith tends to antagonise the mind of its holder against an earlier form.

The rising generation has little if any understanding of the language spoken even so recently as in Berthelot's early days. There are, however, men

 $^{1}$  The English original of an 'appreciation' contributed to  $\it Chimte\,et\,Industrie$  in connexion with the centenary celebrations of Marcelin Berthelot

still alive who knew him, though not at the beginning of his career. Let us hope that these will give us of their best-the details that will enable us to follow his psychological development as a worker. For Pasteur we apparently have this information; the lessons we gain from it are invaluable. We seem to have the clearest understanding of his temperament and to be able to follow the gradual unfolding of his powers: to appreciate the masterly logic of his disposition. to see one continuous line of thought pervading all his labours, above all, his desire to serve his fellows. Berthelot offers a surprising contrast: we know so little of the man. His seems to have been a more universal genius We are in sore need of some thread of continuity to guide us through the maze of his mind.

No episode in the history of chemical science is of greater interest than that of the discovery of dephlogisticated air by Priestley and the instant appreciation of its value by Lavoisier—conveyed in the magic word 'oxygen,' a word, however, the magic of which is not heard by young ears to-day, even in France. We can, in a measure, put ourselves into Lavoisier's position—our habit of thought still being largely that which he introduced in raising chemistry from an empiric art to a philosophy We can no longer enter into the spirit of Priestley's work—we cannot even read his language with understanding. He has been commonly regarded as a pure empiric, but it is impossible to give credit to such estimate of his character. Berthelot, indeed, has questioned the truth of his representation of himself as an empiric. There are numerous passages in his works which may be interpreted as proof that behind all his inquiries there was both method and logical purpose, though maybe the purpose of intuition only. In the preface to his collected works (1790), he himself advocates philosophical studies in the following most remarkable passage:

I am sorry to have occasion to observe that natural science is very little, if at all, the object of education in this country, in which many individuals have distinguished themselves so much by their application to it. And I would observe that, if we wish to lay a good foundation for a philosophical taste and philosophical pursuits, persons should be accustomed to the sight of experiments and processes in early life. They should more especially be initiated in the theory and practice of investigation by which many of the old discoveries may be made to be really their

own-on which account they will be much more valued by them. And, in a great variety of articles, very young persons may be made so far acquainted with everything necessary to be previously known as to engage (which they will do with particular alacrity) in pursuits truly original.

Nowhere, in our schools, have we yet acted up to these recommendations: we pay faint heed to them even in our colleges.

It is my good fortune to be able to overlook the period from 1865 to the present time—an interval of more than sixty years. I still remember how greatly, at the beginning of my career, I

was fascinated by Berthelot's achievements, especially by reading his book on organic synthesis (1860). English chemists, I may say, have always been accustomed to pay close attention to the work of their French colleagues, especially that published in the Comptes rendus de l'Académie des Sciences. Not only is the concise form in which work is there presented eminently attractive but also, almost invariably, the force of genius is apparent in each communication, some new idea being stated, some advance recorded. Moreover, Berthelot compelled attention by his persistent appearance on the boards week after week. "What has he to say this week?" was the unconscious question we asked ourselves,

as each new number came to hand Some point he always made. His method had the advantage that he made his points singly, so they went home.

Myself a student under Hofmann, Frankland and Kolbe, three of the great pioneers of our science on the organic side, I was specially prepared to appreciate Berthelot's early successes in synthetic chemistry. Few to-day will realise how great was the impression he made by his production of alcohol from ethylene

MARCELIN BERTHELOT.

and water, of formic acid from carbonic oxide and soda. of acetylene from carbon and hydrogen — this last a particularly striking discovery at the time when we were beginning to specify orgame chemistry as the chemistry ofhydrocarbons and their derivatives. The barrierbetween the living world and the laboratory had indeed been broken down, in 1828, by Wohler's achievement in preparing urea from ammonia and cyanic acid, but this was a case of Berzelian metameric change, not synthesis. Berthelot went much further and fired our imagination by

showing how two and two might be put together to make four and in ways which were extraordinary in their directness and simplicity. Not only was our vision greatly extended but our ambitions also became boundless. We saw that the pass over the heights was won and that the conquest of the great kingdom beyond was a mere matter of time. We now seem able to make what we will, when once we know what we are called upon to do. No plant is safe from our imitation. The world is arrayed in laboratory products Where our forefathers used woad as a source of indigotin, we use the pure pigment, made by thousands of tons in our factories. The

purple used by emperors in the past, laboriously extracted from multitudinous shell-fish, is now a relatively inexpensive laboratory product but laugh at Nature—in fact, we can do more than she elects to do and arrogantly wear two gloves where she is content with but one, this, her prime secret, however, is her security, it seems, one for which Berthelot did not allow when he suggested that, in the future, perhaps we should live on synthetic food—an unpardonable suggestion for a man belonging to a gastronomic nation to make, a Chemists, it is true, are clear blot upon his shield cooks but the French cook is by heredity an artist and his art one to be held in reverence, not interfered with by science and spoilt—as is brewing.

Still, the example which we perforce have followed, in our mad career of wresting so much of her prerogative from Nature, is that set by Berthelot. His methods of producing alcohol and formic acid long remained in abeyance—there was no call for their application; in recent years, however, they have been developed on the large scale. That of acetylene may be ranked as the most fruitful of his discoveries Produced by the calcium carbide process, which in its essence is Berthelot's, this gas is now used not only as an illuminant but also in the form of the acetylene blowpipe, in welding and cutting steel. Acetylene is also used as the primary material in the production of acetic acid on the large scale If, to-day, though we do not despise Nature, we are tending to put her aside and make coal the uriversal raw material, the initial fault was Berthelot's; if to do so be a virtue, the credit lies equally with him.

Regarding Berthelot, as we must, as the parent of synthetic organic chemistry, we need to be clear in our definition of synthesis, in view of the too general tendency to attach loose meanings to the terms we use and of the danger we run, especially at legal hands, of our terms being misinterpreted by those who have no feeling for their use.

We do well to remember the caution given by Gerhardt in the preface to his "Introduction à l'étude de la chimie " (Montpellier, Fév. 1848):

J'ai cherché, autant que possible, à joindre, dans l'explication des phénomènes, la précision à la clarté, prenant en cela pour modèle les mathématiciens qui ne se servent jamais d'un terme sans en avoir préalablement établi le sens. Il faudra bien un jour arriver à écrire les livres de la chimie comme on écrit une géométrie ou une algèbre; c'est alors sculement que la chimie se répandra davantage dans les masses.

In the following passage Gerhardt uses synthesis as the antithesis of analysis:

Les opérations de la chimie sont de deux espèces: elle détermine les métamorphoses, soit par analyse, soit par synthèse; elle sépare de la matière toutes les parties dissemblables, ou, par un procédé inverse, elle unit ces parties entre elles; elle décompose ou elle récompose. L'activité inhérente à la matière est son moyen; le chimiste la provoque par le contact immédiat des corps hétérogènes; il la renforce ou l'affaiblit par l'intermédiaire des agents physiques, chaleur, électricité, lumière.

The word synthesis can only be given its proper

verbal meaning: that of putting together, in the fashion so perfectly set by Berthelot, by working upwards from simple to complex. To give an example, oxalic acid may be made analytically by oxidation of sugar. it may be synthesised through cyanogen, NC CN. We have reason, however, to believe that in no case are compounds formed directly merely from their atomic constituents. The production of acetylene, in fact, is a highly complex process, involving as it does not only the resolution of the diatomic hydrogen molecule but also that of the carbon complex  $C_z$ , where x is an unknown but probably very high value. The equation may be written

$$x\mathbf{H}_2 + 2\mathbf{C}_x = x\mathbf{C}_2\mathbf{H}_2.$$

In result only is the synthesis simple. If we accept Faraday's teaching, the process is still more complex, involving other factors which make the occurrence of change possible by the inclusion of the interacting materials in an electrolytic circuit. The same may be said of calcium carbide. There is good reason to believe that, in preparing this substance, by heating carbon with lime, in an electric arc, we are but producing calcium in situ and that the carbide is formed by the interaction of carbon and the metal—again under the influence of factors which together with these constitute an electrolytic circuit. The argument is equally applicable to the synthesis of alcohol from ethylene and of a formate from carbonic oxide.

The germ of Berthelot's synthetic achievements is already forecast in his first chemical essay-Action de la chaleur rouge sur l'alcool et sur l'acide acétique " (Annal. de Chimie, 33, 295; 1851). This inquiry was undertaken to ascertain what would happen if simple substances were submitted to a red-heat, as nearly all organic substances of high atomic weight gave similar products, coal-tar being an example. His experiments proved that the hydrocarbons benzene and naphthalene, phenol and various other complex compounds were equally obtainable from the simple substances and so laid the foundation of pyrogenic synthesis. In his essay he insists, in the most definite manner possible, that the synthesis of benzene, naphthalene, etc., from their elements could henceforth be regarded as a fait accompli, inasmuch as acetic acid, from which he had prepared them, had already been produced synthetically, by Kolbe, commencing with carbon bisulphide.

Berthelot, therefore, from the outset, was prepared to give a wide definition of the term synthesis and obviously interpreted it in the sense of the passage quoted above from Gerhardt, whose writings will have been known to him. Moreover, he clearly recognises that Kolbe was his forerunner. The essay is striking testimony to the early

development of his genius.

Milestones remain from which we may infer the state of knowledge at the time when his synthetic work was begun. The volume of Liebig's Annalen (81; 1852) in which Berthelot's essay is reprinted from the *Annales de Chimie* also contains Alexander Williamson's celebrated memoir on the formation of ether. In this, as is well known, the long standing dispite over the relationship of alcohol and ether was finally settled and the constitution of the two compounds made clear The student of to-day has difficulty in picturing the crudity of belief and the slight body of knowledge of his forerunner of those by no means far away times. Williamson's interpretation was a master stroke of genius but an absolute 'bolt from the blue,' taking into account the uncertainty, if not confusion, which prevailed. We know that when he undertook the inquiry, he had not in mind the problem of which, as he ultimately saw, it gave the solution I have vainly sought for a clue to his mental development up to the stage when he suddenly took so great a step forward and defined for all time the alcoholic and etheric functions The nearest approach to an explanation which may be offered is, that he was under the spell of Gerhardt's logical genius, as may be inferred from the consistent manner in which he (also his friend Kekulé) made use of 'typical' formulæ from this time onwards. The alcohol-ether problem was ripe for solution, in fact, owing to the publication of Gerhardt's advanced theoretical views.

Another article of special historical interest, in connexion with Berthelot's work, in the volume of Liebig's Annalen referred to, is a letter from Hofmann to Liebig on "The Application of Organic Chemistry to Perfumery." Hofmann prefaces his account by directing attention to Cahour's work on the oil of Gaultheria procumbens, showing it to be a compound ether. He sees proof of the influence this had upon perfumers in the appearance in our first English Exhibition (1851) of numerous fruit ethers and describes the results of his examination of various samples which he had collected as a juryman—he had found the 'pear oil' to be amylic acetate, the 'apple oil' amylic valerate, the 'pine-apple oil' ethylic butyrate, etc To-day, such synthetic materials are used not only in perfumery but also, on a huge scale, as solvents in the cellulose and varnish industries. Berthelot soon afterwards became interested in the more complex etheral salts and, in fact, began his synthetic campaign by building up fats artificially from glycerol and fatty acids, thus crowning the work of his great countryman Chevreul

The inquiry that has received more attention perhaps than any other published under his name and probably is the most esteemed is that on etherification, in which he was associated with Pean de St. Gilles. Carried out with exceptional care and finish, dealing with a fundamental problem of the highest interest, akin to that which Williamson had dealt with in his interpretation of the conditions of metallic salts in aqueous solution, the inquiry excited the widest interest and was the prototype of many similar inquiries—none the less, even now, we are not fully informed nor agreed as to the precise nature of the process.

A branch of Berthelot's work which appealed to me in my early days was that upon oil of turpentine, in which again he appeared as a pioneer. He was the first to distinguish between the oils from various sources and especially to note the distinctive differences in optical properties.

Acetylene, if not his discovery, was first characterised by him and eventually synthesised from its elements. As this is the most fundamental of all syntheses and the gas is of great technical importance, his name will always be indissolubly linked by chemists with this hydrocarbon and its direct conversion into benzene.

Persulphonic anhydride and persulphonic acid are probably to be ranked as his most important primary chemical discoveries

The most difficult chapter in Berthelot's work to appraise is the thermochemical, including that of explosive combustion Ever a fundamentalist at heart, in this, as in all his other work, he sought for primary values. Commencing in 1865, it covers a wide range. The earlier data are probably uncertain in not a few cases In this, as in most other sections of his work, he was opening up-a new field of inquiry and methods had to be devised and developed. Such work, moreover, was scarcely suited to his imaginative temperament and impetuous mode of attack. It needs not only a highly developed sense of accuracy but also a persistence and patience and a self-denial which few possess. He came into conflict with Julius Thomsen, who was making thermochemical measurement his life work; usually, in the end, they were in agreement Berthelot probably derived his interest in such work from the example set by his great countrymen Lavoisier and Laplace. He sought to generalise and so was led to formulate his well-known three principles. Ultimately he rendered a service which it is difficult to overestimate by his invention of the calorimetric bomb, one of the most powerful engines of research yet devised. Maybe the principle embodied in its use will some day be utilised in the internal combustion engine, when oil is no longer available as a cheap fuel. Hitherto it has been used chiefly in estimating the calorific value of fuels but it has also been of service in analysis.

In fact, thermochemistry seems almost to be a subject of the past. Few to-day will realise how great was the interest we took in Berthelot's and Thomsen's results as they were published. Testimony to my own interest in the subject is to be found in the article "Chemistry," which I wrote for the "Encyclopædia Britannica" (vol. 5, ed. 9), published in 1876. I then quoted characteristic thermal data for most of the elements

It is unfortunate that chemists now so rarely take thermochemical values into consideration. When this is done, interpretations which on the surface may seem plausible are often precluded. An example may be found in the enigmatic behaviour of carbonic oxide. As H. B. Dixon was the first to show, this gas in admixture with oxygen is incombustible when dried, although if the mixture be moistened it explodes, the rate of combustion being more rapid the more moisture is present up to a certain point. This behaviour has been interpreted as proof that combustion takes place through the agency of 'water' in accordance with the equation

 $CO + O\dot{H}_2 = CO_2 + H_2$ . This interpretation is precluded, however, by the fact that the heat of combustion of hydrogen to liquid water is greater than that of carbonic oxide

Wieland has shown that such an interaction apparently does take place under the influence of palladium black but he goes further having observed that traces of formic acid are present in the liquid, he argues that formic acid is the first product

$$CO + OH_2 = H_2CO_2$$

and that this is deprived of hydrogen by the action of the palladium

$$CO_2H_2 = CO_2 + H_2$$

As formic acid has a higher heat of combustion than carbonic oxide, the formation of the acid from the gas would be an endothermic process On this ground, Wieland's modified interpretation of the combustion process must equally be ruled out of order.

On thermo- and electro-chemical grounds we may go even further and premise that carbonic oxide cannot be burnt by ordinary oxygen, even when all other necessary determinative conditions are realised. On the assumption that every chemical interchange is an electrolytic process, whenever 'conducting water' is present as a necessary element in the circuit in which interchange is effected, no action should take place at any potential below that developed in the formation of water from hydrogen and oxygen. To burn carbonic oxide, it is necessary therefore to use an oxidising agent of higher potential than ordinary oxygen, the heat of combustion of carbonic oxide being below that of hydrogen. Hydrogen peroxide is such an agent This oxide is a product of the primary interaction when hydrogen is burnt

To explain the fact that a moist mixture of carbonic oxide and ordinary oxygen is explosive, we therefore need only to assume that on firing the mixture a minute quantity of water is decomposed. that the liberated hydrogen is then at once peroxidised and that the hydrogen peroxide thus produced serves to oxidise the equivalent amount of carbonic All the peculiarities in the behaviour of carbonic oxide on combustion are accounted for by

these assumptions.

The halting use hitherto made of thermochemical data is due, in no slight measure, to a suspicion that the values, in not a few cases, are of doubtful accuracy. The difficulty of interpreting the observed values is a still greater bar. These are all based upon the study of molecular interactions, often complex in character, the direct determination of atomic values being impossible. The difficulty has been in part met, in recent years, by resort to thermo-dynamical reasoning and the introduction of 'electrolytic' methods.

We are in face of this difficulty especially in the case of carbon. Julius Thomsen's numerous calculated values for carbon compounds were all based upon Favre and Silbermann's determination (1842-43) of the heat of combustion of charcoal

carbon, made at a time when the methods were but imperfectly developed.

Berthelot, with Petit, made use of his calorimetric bomb in redetermining the value of carbon in its reputed three forms. They give as the means of closely accordant determinations the 'atomic

Diamond 94,310 gram-degree Centigrade units 94,810 Graphite Charcoal 96,960

Apart from the question as to which of the forms the theoretical heats of formation of carbon compounds may properly be referred, we have yet to show that there are forms of carbon other than the diamond. Now that there is reason to suppose, in view of Sir Charles Parsons's inquiries, that diamond has never been produced artificially, the problem is raised to an acute stage. The probability is that the reported allotropes of diamond (graphite and charcoal) are hydrocarbons containing the minute proportion of hydrogen needed to prevent the carbon atoms from lapsing into the highly stable condition they present in diamond, owing to the symmetrical, uniformly tetrahedral arrangement of the atomic units. The very small difference between diamond and graphite, the relatively large difference between graphite and charcoal are both surprising We cannot accept even Berthelot and Petit's determinations as final.

A worthy monument to Berthelot's memory and genius would be an institute charged with the duty of placing beyond question all the fundamental thermal values and of extending thermochemical study in general A vast field of fruitful inquiry lies open in the hydrocarbons especially.

It is impossible to contemplate the long list of titles—about 1500—to which his name is attached without feeling that justice remains to be done to his phenomenal activity We need a studied, critical analysis of his work, in which the logic of his progress is fitly displayed. The work of poets is considered line by line: their critics seek to reconcile the miracles they have wrought in words with the peculiarities, if not deficiencies, of their moral character. The characters of statesmen, of soldiers, sailors and explorers are often discussed in considering their deeds. Little has been done to analyse the psychology of the scientific mind, to define the special features of the scientific spirit, yet even poets have foreseen that it is the spirit of the future. With most wonderful prescience Shelley has said of man:

"All things confess his strength. . . .

The lightning is his slave; heaven's utmost deep Gives up her stars and like a flock of sheep They pass before his eye, are numbered and roll on! The tempest is his steed, he strides the air And the abyss shouts from her depth laid bare, 'Heaven, hast thou secrets? Man unveils me; I have none!""

Of such order was Berthelot. We need to have the strength of the scientific mind fully unveiled: its weaknesses too, so that we may seek to combat them in the future service of the world.

## Obituary.

MR. H M. TAYLOR, F.R.S.

ENRY MARTYN TAYLOR, at the time of his death the senior on the roll of fellows of Trinity College, Cambridge, was born at Bristol on June 6, 1842, the second son of the Rev James Taylor, D D. After being educated at Wakefield Grammar School, of which his father had become headmaster, he was sent to Cambridge, being elected to a scholarship at his college. He graduated as third wrangler and was awarded the second Smith's Prize in 1865; in that year the late Lord Rayleigh was senior wrangler and first Smith's prizeman, and the well-known economist Alfred Marshall was second wrangler. In the year of his graduation, Taylor was appointed vice-principal (with H. J. Purkiss, the senior wrangler of 1864, as principal) of the newly established Royal School of Naval Architecture and Marine Engineering at South Kensington, afterwards the Royal Naval College at Greenwich. Taylor's most distinguished pupil was Sir W. H. White, later Naval Constructor; the relation, there begun, lasted until the death of the younger man in 1913.

In the last century, Cambridge men of high degrees often looked to the Bar for a career; among mathematicians, the names of Alderson, Pollock, Rigby, Stirling, Webster, Moulton, Levett, readily occur as men who made their mark. Taylor read for the Bar; and he was called by Lincoln's Inn in 1869. He does not appear to have practised, for, elected a fellow of Trinity in 1866, he returned in the year of his call as an assistant tutor of his college. The rest of his life was spent in Cambridge. He was tutor of Trinity from 1874 to 1884, the ten-year period having been established. He remained on the staff as a mathematical lecturer until 1894, thus completing the normal maximum of twenty-five years' service in the college.

The 'seventies were an active time of academic reform in Cambridge. The old Elizabethan statutes had been partially modified by the first Victorian statutes in 1858; but a comprehensive change was made by the Universities of Oxford and Cambridge Act of 1877. Under that Act, each college framed its own statutes for submission to the Privy Council. Accordingly, Trinity proceeded with that duty in a long succession of meetings: it was at one of these that the master (Dr W. H. Thompson) relieved the momentary tension by informing a distinguished very junior fellow, still living, that "we are none of us infallible, not even the youngest." When decisions had been completed, the final drafting of the statutes was entrusted to three of the fellows: Prof. Cayley, whose reputation as a draughtsman long survived his retirement from practice at the Bar: Rev. Coutts Trotter, conspicuous for his share in the organisation of the University, especially in the domain of natural science: and H. M. Taylor, whose legal training proved of high value. Then, and for many years to come, Taylor had a prominent (if not foremost) part in giving effect to the necessary changes in the old system. Independent in thought, and scrupulously just, he maintained

the even tenor of his views, devoted to progress yet mindful of the ancient ways, fair in constructive act, and straight in opposition. Those statutes are now under repeal; their actual initial working owed much to the prudent wisdom of a band of refc. mers, among whom Taylor held a not unworthy place.

From the beginning of his career, Taylor was interested in research, particularly in subjects of a geometrical character His two earliest papers date from 1866, and deal—one with interpretations of planetary formulæ (unwittingly, a return to the ancient Greek cycles), the other with inversion. Later, he wrote on the algebraic theory of envelopes and developable surfaces: and he manifested a productive interest in problems of algebraic distribution, applied to chess and to probability. Gradually, his work converged upon the theory of plane curves and of surfaces · thus he discussed the centre of an algebraic curve (1890), and cubics and quarties (1897–98). Perhaps his most important paper is one dealing with cubic surfaces and a diagram of their twenty-seven lines (Phil. Trans.,

Moreover, Taylor did much work for his friends by helpful criticism of the proof-sheets of their books in passage through the press: particular mention may be made of Rayleigh's "Theory of Sound," Lamb's "Hydrodynamics" (the latest edition of which is dedicated to Taylor), and Forsyth's "Differential Equations" and "Theory of Functions." He produced one volume of his own, the "Pitt Press Euclid": it is too extensive for a schoolbook, and now too conservative for a modern practice which sometimes tends to an anarchic freedom from proof. He also wrote the "Encyclopædia Britannica" article on Newton

When Taylor's college work came to an end, it seemed as if he would be free to proceed in the range of original work belonging to the theory of algebraic curves and surfaces But misfortune seized him at the approach of leisure. In 1894 the sight of one eye failed, through detachment of the retina; and, soon, the sight of the other eye failed also. Though he did succeed in continuing mathematical research for a time with the help of amanuenses, and indeed produced several papers after the loss of sight, so that he was elected a fellow of the Royal Society in 1898, it soon became clear that this form of activity had to be abandoned. He had found the Braille volumes a solace within their range; but the comparative lack of scientific books in Braille type stirred a new idea, the realisation of which opened a new life for him

Taylor set to work and developed the Braille alphabet; he devised amplications which rendered possible the reproduction of mathematical formulæ, figures, and diagrams, even some illustrations of books. He worked in connexion with the association which produces Braille books; but its funds could not bear the high charges necessarily entailed. So some friends, admiring Taylor's courage, collected a small fund to subsidise the association. The result was a fine success. Volume after volume was translated into Braille, text-books on geometry, algebra, come sections, trigonometry, astronomy, geology, the foundations of mathematics, metaphysics, physiology, sound, music, and mechanics—a list that is not complete—were published by the help of the fund. Every symbol on every page of every volume was stippled out by Taylor's own hand, with a cheerfulness and a patience that were amazing. His work is a real contribution to the life of the blind. Financial aid for the work, thus initiated, has been placed on a permanent basis, for his friends gathered funds which, under the name of the Embossed Scientific Books Fund, have been accepted as a trust administration by the Royal Society.

This bond of communication with the world that lives by sight gave Taylor new interests. He remained a member of the council of his college, under the new statutes, being re-elected time after time. He was made a university member of the borough council of Cambridge, served as mayor in 1900–1, and for some subsequent years was chairman of the finance committee of that council. Also he was nominated a borough magistrate, and discharged the duties with characteristic regularity and fairness.

In later years, the burden of age told; and, for nearly two years, Taylor had been practically confined to his house. Unmarried, he made a home for his mother—who, in her nineties, chaffed him when he was mayor—and for his sister who survives him. At that house, The Yews, set in the college backs, he died on Sunday, Oct. 16th last; and on the succeeding Wednesday, after a funeral service in the College Chapel, he was interred in the Huntingdon Road Cemetery.

Taylor's record, from 1894 onwards, is one of rare patience: of serene courage: and of unflinching cheerfulness under calamity, without a word of complaint. He leaves behind him the memory of a man who, for over thirty years, fought his

One fight more, The best and the last.

A. R. F.1

## DR. B. DAYDON JACKSON.

A LONG life of useful work was closed by the death in Westminster Hospital, on Oct. 12, as the result of a street accident, of Dr. B. Daydon Jackson, who since 1880 had been actively associated with the conduct of the Linnean Society.

Born on April 3, 1846, in Stockwell, then near London, Jackson was educated in private schools. Though he seems to have had no special training, he was much interested in natural history; he was one of the early members of the Quekett Microscopical Club, and in 1868 was elected a fellow of the Linnean Society. His interest in our British flora brought him into touch with the botanists at the British Museum and Kew, and his special

aptitude for bibliographical work was soon apparent. In 1876 he edited, with the addition of notes and references and a life of the author, "A Catalogue of Plants cultivated in the Garden of John Gerard, in the Years 1596-1599"; and in the following year a similar reprint and edition of William Turner's "Libellus de re herbaria novus," originally published in 1538 In 1881 the Index Society published in 1538 In 1881 the Index Society published his "Guide to the Literature of Botany"—a classified selection of botanical works, which, though nearly fifty years old, it is still worth while to consult. This was followed in 1882 by "Vegetable Technology," a contribution towards a bibliography of economic botany, also published by the Index Society. Meanwhile, in 1880 Jackson had been elected to the botanical 1880, Jackson had been elected to the botanical secretaryship of the Linnean Society, for which he worked devotedly during the rest of his life, for twenty-two years (1880-1902) as botanical secretary, and then as chief of the permanent staff, with the style of general secretary, until last year, when he retired from active participation in the conduct of the Society, though his services were retained as curator of the Linnean collections. Jackson's work for and association with the Linnean Society is so well known as to need no comment Successive generations of botanists and zoologists will gratefully remember the ready help and advice which was always at their service at the Society's rooms in Burlington House manent expression of their feeling was the presentation of Dr. Jackson's portrait to the Society on the occasion of his resignation of the secretaryship at the anniversary meeting in 1926.

Jackson's most important literary work was the "Index Kewensis"—an enumeration of the genera and species of flowering plants from the time of Linnæus to 1885, the expense for the compilation of which was contributed by Charles Darwin. The work of compilation was begun in February 1882 and the final part was published in 1895. Of the first supplement, bringing the Index up to 1895, Dr. Jackson and Dr. T. Durand, of Brussels, were the authors.

Another invaluable book of reference was the "Glossary of Botanic Terms with their Derivation and Accent," which he issued in 1900; subsequent revised editions appeared in 1905 and 1916.

The Linnean Society is the home not only of the herbarium but also of the library, manuscripts, etc., of Linnæus; an intimate knowledge of these brought Dr. Jackson into touch with workers, especially taxonomists, at home and abroad. His various publications on the Linnean collections, and his recent English edition of Prof. Fries's "Life of Linnæus," may be mentioned. So highly was this aspect of his work appreciated in Sweden that at the Linnean bicentenary celebrations at Upsala in 1907 he received special honour, including a knighthood (R.N.O.), and the Hon. Ph.D. and A.M. of the University. His last important work was the recently issued catalogue of the Society's library.

The remarkable vigour of Jackson's constitution—he had never missed a meeting of the council during his forty-seven years' continuous service,

<sup>&</sup>lt;sup>1</sup> Some passages in the foregoing are taken from the writer's obituary notice which appeared in the Times, Oct 17.

and only one general meeting—gave hope that he would for some years more be able to fulfil the light duties assigned to him as curator of the Linnean collections—It has been ordered otherwise and he has fallen, literally almost, at his post.

#### Prof. A Mair.

PROF ALEXANDER MAIR, whose death occurred on Oct 7 at the comparatively early age of fifty-seven years, had occupied the chair of philosophy at the University of Liverpool since 1910 Although he made no direct contribution to purely scientific research, he was always keenly interested in recent developments of scientific theory, and extremely appreciative of their wider philosophic implications. He was the author of the articles on "Hallucination" and "Belief" in "The Encyclopædia of Religion and Ethics," of "Philosophy and Reality" (published 1911), and of "Immanence and Transcendence," and "The Idea of Transcendent Deity," in recent volumes of the *Proceedings of the Aristotelian Society*.

Prof Mair was born in Glasgow, and pursued his studies at Edinburgh, the Sorbonne, and Marburg He exercised a marked influence both within the University and in connexion with many extra-mural educational institutions, being also the first president of the recently founded Liverpool Psychological Society and active in promoting the Liverpool Branch of the British Institute of Philosophical Studies; while his philosophy seminar was attended by a growing number of post-graduate students His intellectual ability, combined with his generous disposition and patent sincerity, gained for him a wide sphere of appreciation.

WE regret to announce the following deaths.

Rev. H. N. Hutchmson, author of "Prehistoric Man and Beast," "Extinct Monsters," and other popular books on scientific topics, on Oct. 30, aged seventy-two years.

Dr. J. R. Leeson, mayor of Twickenham and author of "Lister as I knew him," who also interested himself in several aspects of natural science, on Oct. 23, aged seventy-three years.

### News and Views.

SIR ALFRED MOND'S address on the chemical industry, read by Dr. F. A. Freeth before the Central Economic League on Oct 20, ought to receive wide publicity, for it tells the plain man in plain terms how that industry, particularly in Great Britain, stands in relation to his own daily needs, his protection, his future requirements, and, in fact, his very life. Such a pronouncement, coming as it does from the chairman of Imperial Chemical Industries, Ltd., the great merger of Brunner, Mond and Co., Ltd., Nobel Industries, Ltd., British Dyes, and the United Alkali Co., Ltd., with a total of seventy-five constituent and associated companies, cannot fail to ment the closest attention of economists and of all those interested in the different aspects of the social welfare and development of the race. An analysis of the ordinary doings of the ordinary man throughout the twenty-four hours has shown that all the objects with which he deals, and most of the food he eats, have at some time or other come within the province of chemical industry. Chemicals, in fact, form the foundation of the world's industries, and hence are to be found at the very root of Imperial security and prosperity. It is of course not only the chemist who carries the technical responsibility in these concerns; as Sir Alfred Mond remarked, good engineering can also turn an unprofitable chemical process into a profitable one, notwithstanding that the same chemical reaction has been used under comparable conditions in each case. The new fertiliser process at Billingham, for example, depends for its success on the application of extremely high gas pressures. The development of an industrial technique of high pressures not only leads to commercial success in one branch of the industry, but also opens up new avenues of research and application of immeasurable national and Imperial significance.

PROBLEMS relating to agriculture, to the ultimate dependence of the food supply on the production of

fertilisers from the atmosphere, to the new realisation of the value of systematically fertilised grassland, to the possibility of the synthetic production of vitamins, were all brought under review, and attention was directed to what may be termed the 'fuel problem.' Sir Alfred Mond views with equanimity even an exhaustion of the world's timber supplies, believing that, if necessary, chemical industry would undoubtedly come to the rescue with a substitute. More remarkable still is the movement by centralised industry in repairing the deficiencies of that local chemical works which each one of us possesses in his own body. Synthetic isulin, for example, as effective m its action as its natural counterpart, is at least a vision of the early future. In speaking of industrial peace, Sir Alfred Mond referred to the fortunate happy and friendly past of the chemical industry, and outlined the plans which had been laid within the organisation of which he is chairman, with the view of promoting personal contact, improved status, increased security, co-partnership in profits, and co-operation. In the concluding words of the address. "The achievement of industrial peace cannot be hastened merely by the desires of enthusiastic amateurs or disillusioned politicians. It can be secured only by the competence and good will of those in whose hands are placed the responsibility for industrial organisations, whether on the side of direction or on the side of labour. There is a new spirit and a new science in the management of chemical industry. That new spirit and new science is the broad avenue to industrial prosperity and industrial peace."

MR. J E. WILLIAMS, whose interesting book, "In Search of Reality," was reviewed in NATURE of June 5, 1926, writes with reference to the leading article, "Science and Philosophy," which appeared on Oct. 22, to protest against any mechanistic explanation of

evolution being accepted as firmly established criticism is directed mainly against Sir Arthur Keith's address to the British Association, in which it was stated that evolution has been accomplished "under the action of forces which can be observed and measured." Mr. Williams considers that the public have taken this statement to mean an endorsement of the mid-Victorian belief in the sufficiency of natural selection, and generally as a pronouncement in favour of a mechanistic explanation of the evolutionary process. It is, he believes, "such unwarrantable materialistic dogmatism regarding the cause of evolution which has given rise to the resentment against the whole theory so manifest in religious circles at the present time." No doubt Mr. Williams is right in his diagnosis of the cause of this resentment; we would, however, point out that the leading article which was the immediate occasion of his letter expressly advocated a reconsideration of biological conceptions, and in no way proposed as sufficient or final any mechanistic views, whether of life or of evolution.

THE movement of a mountain, Monte Arbino, 5560 feet in height, is giving rise to such anxiety in the neighbourhood of Bellinzona, three miles to the east of which it is situated and not very far from the northern end of Lago Maggiore, that the authorities of the Ticino Canton in which it lies (the Italo-Swiss frontier crossing the northern end of the lake at Brissago) have ordered the evacuation of the zone of danger. The mountain has been moving horizontally since 1888, and in 1905, when the Federal Geological Survey directed attention to it, the summit had moved eastwards more than six feet in the interval. Since then it has been moving at an increasing rate per year, until during last year, 1926 alone, it had moved a foot. It has simultaneously lowered in height to a little more than the same extent, fourteen inches in 1926 The moving mass covers 2520 square yards. The movement has now reached such proportions, and such large and numerous cracks and crevasses have developed which have widened rapidly in the last few months, that the neighbouring hills of La Monde and Chiara are ordered to be evacuated, and all building operations or the felling of trees are prohibited. On account of the movement trees on the slopes of the mountain are leaning very considerably and more and more out of the perpendicular, and from time to time large falls of earth and rocks are occurring. The Survey experts believe that the mountain will before long crash down into the valley of Arbedo, and that nothing can be done to avert the fall, which, while the town of Bellinzona is itself happily protected by a granite ridge, would overwhelm the picturesque villages and farms with their groves of chestnut trees and firs, together with a large area of forest land and valuable pasture meadows.

It was announced in the *Times* of Oct. 29 that the Nobel Prize for Physiology and Medicine for 1926 had been awarded by the Karolinska Institute, Stockholm, to Prof. Johannes Fibiger, of the University of Copenhagen, and that for 1927 to Prof. Julius Wagner von Jauregg, of the University of

Vienna. The award for 1926 has, however, already been announced (see Nature, Nov. 27, 1926, p. 778). Prof Fibiger is perhaps best known by his work on the experimental production of cancer in rats behaviour of an animal with a transplanted cancerous growth may not be the same as that of one in which a tumour spontaneously develops. Filiger succeeded in producing growths of the stomach and tongue in rats by feeding them with cockroaches infested with a small nematode worm, which may be the cause of similar tumours developing, apparently spontaneously, under natural conditions. The method has enabled material for the study of the development of cancer to be obtained under experimentally controlled conditions Prof Wagner von Jauregg is well known as the originator of the malarial treatment of general paralysis of the insane. The treatment is based on old observations that the disease is frequently benefited by prolonged suppuration or fever. The first development of these observations was the production of pyrexia by means of injections of tuberculin or typhus vaccine, but more striking improvements occurred in patients who had fortuitously developed some infection Wagner von Jauregg therefore began treating patients in 1917 by inoculation with benign tertian malaria, and the method has now been used extensively both by him and by workers in other countries. Apparently permanent remissions occur in about half the cases, and many of the remainder are considerably benefited. The patient is allowed to have about a dozen typical malarial attacks and is then cured by the administration of quinine, to which the inoculated disease readily responds If the initial remission is complete, it appears to last for several years and the future may prove it to be permanent, at any rate in certain cases.

THE earthquake of Oct 24, of which a brief notice was given in our last issue (p. 630), seeins to have originated somewhere off the Alaskan coast From the seismograph records at Oxford, Kew, and Helwan, Prof. Turner suggests that it may belong to the same focus as a much weaker earthquake on Nov. 29, 1920, or in lat. 59° N, long. 149° W This position, which is about 50 miles south of the Kenai Peninsula and 320 miles west of Yakutat Bay, agrees fairly with the estimates of the distance of the origin from the University of California (1500 miles) and Ottawa (2615 miles). The evidence, so far as it goes, is somewhat conflicting. The shock seems to have been felt most strongly in the south-east of Alaska, and but slightly in northern Alaska. The telegraph cable was broken in two places, near Wrangell and between Juneau and Skagway, that is to say, in the narrow sounds of the Alexander Archipelago. Moreover, no seawaves were recorded at Honolulu, and none have been reported from San Francisco, and these might have been expected with a submarine earthquake of this magnitude. On Sept. 3 and 10, 1899, two of the greatest of recent earthquakes occurred in Yakutat Bay. They were accompanied by the most remarkable uplifts (of so much as 47 ft. 4 in.) known to us, measured six years later by the height of dead barnacles still adhering to the rocks. The epicentral area crossed narrow sounds, and, on account of the small volume of water raised, the sea-waves, though observed on the surrounding coasts, were not perceptible at great distances. It is possible that the epicentro of the recent earthquake may have occupied a somewhat similar position among the channels of the Alexander Archipelago.

Interesting records of the Alaskan coast earthquake of Oct 24 were obtained at Kew Observatory. The direct longitudinal waves (P) arrived at 16 hr. 10 min 39 sec. G.M.T., and the direct transverse waves (S) 525 seconds later. This time interval corresponds with an epicentral distance of 7320 kilometres. First and second reflections of both P and Swere recognisable. The direct surface waves were well developed, as also were those which had travelled by the long path (that is, via the antipodes). These return waves arrived 21 hours after the P phase largest earth displacement recorded on the east-west component seismograph during the surface phase amounted to 220 microns. For the Japanese earthquake of Mar. 7, 1927, and the Chinese earthquake of May 22, 1927, maximum displacements of about 500 microns were recorded.

DURING the recent visit of the Imperial Agricultural Research Conference to Edinburgh the delegates inspected the Annual Breeding Research Department of the University, the Animal Diseases Research Association, the Royal (Dick) Vetermary College, the Plant Breeding Station, and the Board of Agriculture Seed Testing and Plant Registration Stations. On Oct. 28, the Right Hon Sir John Gilmour, Bart, Secretary of State for Scotland, received the honorary degree of LLD, and delivered his address as Lord Rector of the University to the students He emphasised the clamant need for men fitted to engage in research, and said that for these they must look to the universities. The finding of satisfactory answers to two great questions--" How can we improve production?" and "How can we secure for the product the most complete immunity from the onset of disease?" -is a matter of vital concern to the home country. The extent of the British Empire and the bewildering variety of climates and soils and of animals and plants place it in a unique position as regards opportunities for research. Peculiar importance attaches to that part of the Empire which has in the tropics, for there Nature holds out the largest promise of adding to the economic wealth of the world and thereby raising the standard of comfort for mankind in general. He urged those who have the qualifications for research to realise the new opportunities which are presenting themselves and, in weighing up the prospects of a career, not to leave out of account what may be waiting beyond the seas.

At the luncheon in honour of the Lord Rector, which followed, the Earl of Balfour referred to the great advances due to those who ardently pursued knowledge without the least idea that that knowledge was going to make any material difference either to their own fortunes or to the fortunes of the world. He pointed out the difficulty of apportioning the amount of support which ought to be given to researches which

seem on the face of them completely useless, and to others in which principles are applied to the actual A great discoverer cannot be work of the world. made, but every university ought to try to give such men the chances which will enable them to make use of their unique gifts Lord Balfour said it is not easy and is not going to be easy to find enough persons with the education and the capacity to turn discoveries to the best account, but every university must set itself to do its best. The expansion of the whole apparatus of university education is a most expensive business, and the gifts of new chairs and laboratories place pecuniary obligations on the university, so that such gifts are in themselves the leason why more money is required.

A CHADWICK Public Lecture on "Tropical Vegetation and some of its Uses to Man," was delivered by Mr. W. Hales, Curator of the Chelsea Physic Garden on Oct 27. Mr. Hales was granted leave of absence by the Trustees of the Garden for the purpose of seeing tropical vegetation under natural conditions, and described in his lecture the salient features of the native vegetation and agricultural crops seen in his visit to Ceylon, the Straits Settlements, Malaya, and Java. The work of the Royal Botanic Gardens, Peradeniya, Ceylon, was referred to, and the cultivation of tea in that country was described. At Penang, the waterfall gardens are famous for their beauty, and large numbers of rare plants have been distributed from there to other gardens. From Taipang, Malay, a tour of inspection of the mangrove swamps was made; these swamps yield a large revenue to the Government from the sale of wood. Kuala Lumpur and its agricultural station were next visited. The introduction of rubber into Malaya was alluded to, and some of the research work done on rubber growing was described. In Java, the principal crops are rice, sugar-cane, and emchona for quinme, 90 per cent, of the world's supply of this drug coming from Java. The botanic gardens of Buitenzorg contain the richest collection of plants of any garden seen by Mr Hales in the East, and as a scientific institution it ranks next to the Royal Gardens at Kew.

LECTURING on "Eugenics in the Future" at Bod ford College, University of London, on Oct. 25, Major Darwin protested against the attack on eugenic reform as materialistic. It is not materialistic to use the history of the past to supply guidance for conduct in the future. Science affords no clue to the ultimate meaning and aim of the universe- these are the problems of religion and philosophy—but a scientific study of the laws of Nature enables one to form reasonable expectations as to the result of processes affecting the mental and physical development of man. Study of evolutionary principles affords the surest guide to the betterment of the race. Eugenists are in favour of schemes for social amelioration, but are convinced that they are not enough to secure social progress. The disproportionate birthrates of the more and less valuable strains at present show that all is not well with society: decrease in racial quality may coincide with an increase in material prosperity which obscures

the underlying causes of eventual deterioration. The public is not ripe for drastic eugenic legislation, even where it is desirable, but patriotism and enlightened public opinion can help to increase the birthrate of the better stocks. Self-control on the part of those with such family taints as insanity, segregation of the mentally deficient, some form of pressure applied to persons in chronic receipt of relief who have proved unable to maintain themselves or their families, and more enlightened treatment of habitual criminals, would curtail the birthrate among the less desirable strains.

Mr. Archibald Page, president of the Institution of Electrical Engineers, gave his inaugural address on Oct. 20. As Mr. Page is the engineer and manager of the Central Electricity Board, his address was looked forward to with great interest. He pointed out that our progress would have been more rapid had it not been for the rivalry between large electrical undertakings and the overzealous display of local patriotism by the smaller municipal undertakings There is no infallible remedy for the present state of things, but methods of generating electricity must be altered. In particular, electrical stations must be interconnected by a system of high-tension lines. These lines will be supported on towers eighty feet high and sixteen square feet at the base. Their design was settled after consultation with Sir Reginald Blomfield. The conductors, the pressure between which will be 132,000 volts, will be spaced at a distance of 12 feet apart. The lines will be made of aluminium with a steel core to strengthen it mechanically. The step down transformers will vary in size from 10,000 to 75,000 kilowatts, and the voltages will be varied to suit the requirements of the distributing stations Amongst the advantages claimed for 'the grid' scheme is that it will allow of the aggregate amount of spare plant to be considerably reduced, and that it will enable 'blocks' of waste heat from blast furnaces, coke ovens, and other sources to be transformed into electricity and thus usefully employed. In his last Budget speech, the Chancellor of the Exchequer said that there were signs that the centre of gravity of industry in Great Britain is moving south. By means of the grad, power can be given to facilitate the development of industry wherever it is wanted. The new scheme, however, will not appreciably affect the cost of lighting in our big cities which have modern power stations.

PRITZEL'S Iconum Botanicarum Index, which is a list of references to illustrations of flowering plants and ferms in botanical, horticultural, and other publications, has been a standard work of reference since its completion in 1865. In 1917 the Council of the Royal Horticultural Society decided to undertake the revision and continuation of Pritzel's Index, and the work has been carried out at Kew under the editorship of Dr. Otto Stapf, late Keeper of the Herbarium, with the help of the facilities of, and material already to hand in, the Kew library. Pritzel's Index contained more than 107,000 references; the new edition, which bears the title Iconum Botanicarum Index Londinensis, will contain 450,000

references, including those in the original work, to illustrations of flowering plants, ferns, and fern allies published in botanical, horticultural, and other works and journals between the years 1753 and 1920. It is also proposed to issue periodic supplements. The Index will be as complete as it has been possible to make it by consultation of the libraries at Kew, the Natural History Museum, and elsewhere, and with the help of assistance from botanists on the continent of Europe and in America The first portion is ready for press, and a circular has been issued by the Royal Horticultural Society announcing its appearance The Oxford Press is printing the *Index*, which will have the same size and form as the Index Kewensis, the references being arranged in three columns on a quarto page, alphabetically under the genus name. It will appear in six volumes, two of which will be issued in each of the years 1928, 1929, and 1930. The subscription price is £25 Intending subscribers should apply to the secretary of the Royal Horticultural Society; it is stated that the edition will be strictly limited

ALTHOUGH the front of Faraday House Electrical Engineering College suffered considerable damage by the crane which fell in Southampton Row on the night of Oct. 28, it has been found possible to carry on the work of the College. The testing laboratories received but little damage, and the work of the Standardising department is proceeding normally.

The following have been elected office-bearers of the University of Durham Philosophical Society for the session 1927–1928:—President, The Chancellor of the University—The Earl of Durham; Hon. Sec., Dr. D. A. Allan, Hon. Treas, J. W. Bullerwell; Editor of Proceedings, Prof. G. W. Todd; Chairmen of Sections—Chemical and Physical, Prof. W. E. Curtis; Geological and Biological, Prof. J. W. Heslop Harrison; Mathematical, The Rev. F. H. Jackson; Archæological and Historical, Prof. J. W. Duff; Applied Science, Dr. J. Morrow; Philosophical, Prof. J. W. Harvey.

The third annual Norman Lockyer Lecture—established by the British Science Guild as a means of periodically directing the attention of the public to the influence of science upon human progress—will be given by The Very Rev. Dean Inge, in the Goldsmiths' Hall, Foster Lane, E.C 2 (by permission of the Goldsmiths' Company), on Monday, Nov. 21, at 4.0 p.m., the Right Hon. Sir Alfred Mond, Bart., president of the Guild, in the chair. The subject of the lecture is "Scientific Ethics." Tickets may be obtained from the secretary of the British Science Guild, 6 John Street, Adelphi, W C.2, if application is inade not later than Monday, Nov. 7.

The Institute of Physics announces the thirteenth lecture of its series, 'Physics in Industry,' which is to be given at 5 30 p.m. on Monday, Nov. 14, 1927, in the rooms of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2. The lecturer on this occasion is Sir William Hardy, Director of Food Investigation at the Department of Scientific and Industrial Research, and his subject,

"Physics in the Food Industry." The application of physical methods to the conservation of food resources is a subject of national importance, and the lecture should be of considerable interest to a far wider public than the membership of the Institute of Physics. The Board of the Institute wishes it to be known that the lecture is open to the public, without charge. Admission is by ticket, and tickets may be obtained on application to the secretary of the Institute of Physics, 1 Lowther Gardens, Exhibition Road, London, S.W.7.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned -Two jumor assistants (engineering) for research work at the Fuel Research Station, East Greenwich Special knowledge of mechanical engineering in the case of one vacancy, and of physics and mathematics in the other case, is desnable - The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Nov. 14). A head of the building department of the Leeds Technical College -- The

Director of Education, Education Offices, Leeds (Nov. 14). A bacteriologist at the Devonshire Hospital, Buxton-The General Superintendent and Secretary, Devonshire Hospital, Buxton (Nov. 15). A plant physiologist and a plant pathologist at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, for banana research—The Secretary, Imperial College of Tropical Agriculture, 14 Trunty Square, E.C.3 (Nov. 30). A professor of pathology and bacteriology at the Welsh National School of Medicine-The Registrar, University College, Cardiff (Dec. 1) A dairy research bacteriologist at the Research Laboratories, New Zealand-The High Commissioner for New Zealand, 415 Strand, W.C 2 (Dec. 17). A lady tracer at the Admiralty Engineering Laboratory, West Drayton, Middlesex—The Superintendent, Admiralty Engineering Laboratory, West Drayton, Middlesex. A signal inspector for the Engineering Department of the Egyptian State Railways, Telegraphs and Telephones—The Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.I.

#### Our Astronomical Column.

MAGNETIC DISTURBANCES AND SUNSPOTS.—On Oct. 22, a magnetic disturbance commenced sharply at 63h and continued until 10h on Oct. 23 with an intervening diminution between 16h and midnight. During the first phase the excursion shown by the Greenwich declination magnetograph traces was 3°, and during the second about 40'. The disturbance is worth comment on account of its being one of those instances in which it does not appear possible to ascribe a connexion between a pronounced magnetic disturbance and a particular sunspot. A small stream of spots crossed the sun's central meridian on Oct. 22-26, but in general appearance it was but one of many which are now of frequent occurrence. An examination by Mr. Evershed of spectroheliograms taken at his observatory at Ewhurst, Surrey, also failed to show any unusual solar activity (the daily record at Ewhurst, as elsewhere in Great Britain, was, however, broken by cloudy weather).

It may perhaps be noted that at the time of the commencement of the magnetic disturbance the longitude of the sun's central meridian was 282°, and that this particular longitude was the position of three very large spots seen successively on the central meridian on May 12, June 8, and July 5 respectively. At the time, attention was directed to the absence of corresponding magnetic disturbances which might reasonably have been expected in view of the size and nature of the spots (see NATURE, June 18, p. 903, and Proceedings of the Astronomical Society of the Pacific, August, p. 246).

Another instance this year of the occurrence of a magnetic 'storm' and the apparent absence of any solar activity of note was afforded on July 21-22.

THE TRANSIT OF MERCURY ON NOV. 10.—The British Isles have been favoured as regards visibility of transits of Mercury in recent years. In the period since 1861 there have been nine transits, 3 in May, 6 in November, of which only one, that of 1881, was wholly invisible here, while those of 1907, 1914 were wholly visible, the middle occurring at noon. There will be a transit on the morning of Thursday, Nov. 10, of which the end will be visible in Great Britain, the sun rising at Greenwich at 7h 8m, and internal contact at egress occurring at 8h 28m. The transit is

a nearly central one, Mercury being 2'9" south of the sun's centre at 5h 46m.

Now that accurate time can be obtained so readily by radio signals, it is well to point out that amateurs can do most useful work by carefully timing the contacts, both internal and external. Such observations have a double value. First, it was largely through observations of transits that the anomalous motion of the perihelion of Morcury was detected, which was afterwards explained by Einstein. The amount of the advance of the perihelion is not yet known with absolute precision, and more observations are desirable. Secondly, it is suspected that the unexplained irrogularities in the moon's motion are due to changes in the rate of the earth's rotation. This suggestion can best be checked by observing the other rapidly moving bodies in the solar system, of which Mercury takes the first place.

Another desirable research is to examine whether any ring of light can be discerned round the portion of the planet outside the sun's disc. Such a ring was plainly seen at the last transits of Venus, being due to sunlight refracted by the planet's atmosphere. It is known that Mercury's atmosphere must be rare, but it is desirable to test whether it has any that can be

detected.

The next three transits are in Nov. 1940 (invisible here), Nov. 1953 (beginning visible here), May 1957 (invisible here). Most of the text-books indicate a transit in May 1937. There will be a near approach, when Mercury will probably be discernible in the spectroscope, projected on the chromosphere, but no actual transit.

THE ASTROGRAPHIC CATALOGUE.—Several more volumes of this catalogue have lately been published, and the end seems to be nearly in sight. The Cape volume for -49° is the last volume but one of the zone undertaken by that Observatory. It consists of 452 pages with 180 stars on each full page. Further instalments of the Catania Catalogue have lately appeared, containing  $0^{\rm h}$  to  $3^{\rm h}$  of  $+47^{\rm o}$ , and  $3^{\rm h}$  to  $6^{\rm h}$  of  $+49^{\rm o}$ . They give right ascension and declination for every star, which is undoubtedly convenient, but was rejected by most observatories as adding too much to the labour and expense of publication.

### Research Items.

MEDICINE AND SURGERY IN ANCIENT EGYPT —In Science Progress for October, Dr. Warren R. Dawson maintains, as the result of a direct study of Egyptian medical texts, that the generally accepted accounts of Egyptian medicine consist of a series of generalisations, many of them quite erroneous and based upon incorrect readings which have been copied from book to book for the last fifty years. There are a number of medical papyri in existence, of which the best known is the Ebers. Egyptian medical knowledge was clearly based upon magic, as is shown by the use of incantations by the object of the treatment, as indicated by the form of its title in the papyrus, such as 'against,' or 'to banish,' or 'to drive out' the disease, which was evidently conceived as a possession, and by the fact that even effective remedies were used magically. Some of the remedies were deliberately made disgusting or unpalatable to the possessing spirit. Surgery, however, the recently discovered Edwin Smith papyrus, which deals with the treatment of wounds, shows to have been based upon exact and scientific knowledge. This was due to the practice of mummification which early gave the Egyptians a knowledge of comparative anatomy. The hieroglyphic signs for the organs of the body are pictures of the organs themselves, but the fact that they are animal and not human organs is evidence that the Egyptians were first acquainted with the structure of the lower animals. The practice of mummification again also gave them a knowledge of physiologythe Ebers papyrus contains several sections dealing with the heart and its functions. Although the meaning of the terminology is not always clear, owing to lexicographical difficulties, and drugs, symptoms, and diseases, all alike are obscure at times, several diseases have been identified and the mummies themselves have furnished evidence of certain pathological conditions. Generally speaking, the diseases are those which attack the fellahin to-day, -mtestinal troubles due to bad water; worms and other parasites, ophthalmia and other infections of the eyes; boils, bites, skin diseases, bilharzia infection, and mastoid disease among others.

THE BIOLOGY OF A WHEAT JOINTWORM PARASITE. -The Wheat Jointworm (Harmolita tritici) belongs to a family of chalcids which includes many plant feeders. This habit is unusual, since most members of the Chalcidoidea are parasites of other insects The Harmolita is extensively parasitised by another chalcid, Eurytoma parva, which curiously enough befongs to the same family (the Eurytomidæ) as its host. The life-history of this parasite has recently been worked out in the United States by Mr. W. J. Phillips, who contributes an interesting paper on the subject in the Journal of Agricultural Research (vol. 34, 1927, pp. 743-758). It appears that the female Eurytoma prefers to oviposit in wheat stems contaming Harmolita larvæ in their first instar. Having consumed its host, the Eurytoma then apparently proceeds to complete its development by feeding upon the plant sap. There is evidence also that, if a Eurytoma, on hatching from the egg, finds itself outside a cell containing its host, it feeds straight away on plant sap and does not seek out the Harmolita. In one instance Mr. Phillips mentions that a larva of the Eurytoma that had evidently consumed a Harmolita larva and had begun to feed on plant sap, was reared to maturity upon a fully grown larva of Harmolita. It is evident that the feeding-habits of the Eurytoma are in a plastic condition and that the insect is gradually forsaking its normal parasitic mode of life and becoming a plant-feeder.

VARIATIONS IN THE PROTEIN CONTENT OF WHEAT. -W F. Gericke (Journal of Agricultural Research, vol. 35, p. 133) brings forward some explanation as to why applications of nitrogen to land may cause either an increase or decrease in the protein content of wheat. Starting with experiments on wheat grown in nutrient solutions, he showed that in a series of plants initially supplied with a complete culture solution, but later transferred to one from which a different essential element was omitted in each case, those deprived of calcium or nitrogen alone had the protein content of the gram affected; a decrease occurred in both cases. Tests were also made with a number of different wheat varieties grown in soil, the plants either receiving no nitrogen or dressings of sodium nitrate at different stages of development. The later applications (after 90 days' growth) invariably resulted in the production of high-protein grain, whereas a dressing of nitrogen at the time of planting gave a low-protein grain, and in some cases even decreased the protein content below that of the untreated sets. These varieties of wheat also showed widely different degrees of response to the nitrogen treatment in respect to tiller formation, due to the physiological and genetical properties of the plants. Some tillered freely only after a late dressing of nitrogen, while others tillered equally well whether the intrate was supplied late or at the time of planting. The explanation suggested from the correlation of these results is that where early tillering occurs, the relatively large vegetative growth gives inception to more gram than would result from a plant tillering later and further utilises most of the available nitrogen; the low-protein content of the grain in such cases is accordingly attributed to a shortage of nitrogen at the critical period. It is, therefore, possible to produce high-protein grain by supplying nitrogen to the soil during the later growth stages or by curtailing excessive grain production. Further, such experiments emphasise the fact that the properties of different wheat varieties may have an important bearing on the efficiency of any fertiliser treat-

AMPULLARIDÆ OF JAMAICA AND CUBA.—Dr. H. A. Pilsbry publishes a revision of the Ampullaridæ of Jamaica and Cuba (Proc. Acad. Nat. Sci. Philad., vol. 79). Though the members of this family present in the Greater Antilles are not rare and have been known for a long time, the literature relating to them has remained in confusion. The author uses "the generic term Ampullaria in connexion with these species because being customary it will be generally understood." This departure from orthodox methods in a systematic treatise is the more regrettable when made by one who has a world-wide reputation for systematic work and elsewhere has employed the more correct name of Pila, though he misattributes it to Roding, the editor, and not the author of Bolten's Catalogue. Dr. Pilsbry is unable to separate, as others have done, the commonest one of the Cuban forms from the Ampullaria paludosa, Say, of Florida and Georgia, and has had to change the name in the case of another species.

NEW FOSSII. PRIMATES FROM INDIA.—In Palæontologia Indica (vol. 4, new series), Dr. Pılgrım has published an account of a fragment of a palate of a new species of the important genus Sivapithecus (S. himalayensis). The paper also describes other primate material, there being further new species of Sivapithecus, of Palæopithecus; and two new genera;

Hylopithecus, of which only a single tooth is preserved, and Pondaungia, the true affinities of which are still in doubt. The author also discusses the evolution of the Anthropoidea in view of this new material and with reference to criticism of his already published views.

PRIMITIVE ARTIODACTYLA —Miss Pearson has given an account (Trans. Roy. Soc., B, vol. 215, 429) of the skulls of early Tertiary Stude and other primitive Artiodactyla, paying particular attention to the structure of the otic region. This interesting work is the outcome of a tour round most of the important university and public collections of Europe endeavour to disentangle the relationships of the primitive artiodactyls by an examination of the structure of the dentition alone results in great confusion Miss Pearson, wisely confining herself to an intensive study of the basicranial and otic regions as likely to be more conservative in their evolution than teeth, has made a survey of every specimen well enough preserved for the purpose of this investigation. Although such material is none too common, results of undoubted value and interest have emerged It can be shown, for example, that, although the North American Percherus and the European Palæocherus of the same period are at first sight so similar, the former is a primitive peccary and the latter a primitive true pig Cebochærus is suggested as being close to the ancestral line of the hippopotamus, and light is thrown on the position of other early artiodactyl genera. The paper is well illustrated with more than fifty line drawings, and is a valuable contribution to the study of extinct mammals.

RADIUM D, E, AND F -A number of track photographs obtained by S. Kikuchi with a Wilson expansion apparatus, which are described in the Japanese Journal of Physics (vol. 4, p. 143), throw some light on the mode of disintegration of these elements. source used was a silk fibre, which had been activated by contact with the surface of an old emanation tube, and was stretched across the cloud chamber. In addition to the  $\alpha$ -trails of radium F, two distinct sets of  $\beta$ -trails were found to be present, the long group being attributed to radium E, and the short group to radium D. Within the limits of the probability fluctuations, the total numbers of a-trails and of fast β-trails which appeared on 80 plates were equal, thus confirming an earlier result that radium E emits one  $\beta$ -particle on disintegration. No pairs of tracks were found which could be regarded as those of rays emitted from the same atom. It is suggested that the primary rays of radium D leave the atom with too little energy to be recorded, and that its  $\beta$ -radiation which has been observed is all of secondary origin.

Specific Heats.—The well-known technical method of heating by bombardment with cathodo rays has been applied quantitatively by H. Klinkhardt to the measurement of specific heats (Annalen der Physik, vol. 84, p. 167). A specimen of the substance to be my estigated is supported on quartz in an evacuated enclosure, and brought to any desired temperature between 100° C. and 1000° C. in an electric oven. It is then made the anode for an electron discharge at a few hundred volts from an oxide coated filament, and its subsequent change in temperature is followed by means of an embedded thermo-junction. The rate of supply of energy is known from the current and voltage, due allowance being made for contact differences of potential, and after applying the usual calorimetric corrections, the final results are claimed to be correct to within 2 per cent. Insulators and liquids

can be studied inside a hollow metal electrode. Measurements of the specific heats and of latent heats of change of phase are recorded for ammonium chloride and for a number of metals and alloys, and particular interest attaches to the behaviour of iron and nickel at their Curie points, where the specific heat was found not to fall abruptly to a value characteristic of the unmagnetised material, but merely to pass continuously and reversibly through a sharp maximum.

THE PROTECTION OF ALUMINIUM AND ITS ALLOYS AGAINST CORROSION.—A paper by H. Sutton and A J. Sidery, read before the Institute of Metals on Sept 8, contains a full account of the process of anodic oxidation of aluminium devised by Bengough and Stuart Sutton and Willstrop, by volatilising the metal in a stream of dry hydrogen chloride, have shown that the film produced consists of a coating of aluminium oxide of the order of 1 µ thick Especially when a grease such as lanoline is afterwards applied, the anodic oxidation affords an excellent means of protecting the metal and its alloys from sea-water corrosion As a result of the great 'throwing power' of the anodic process, samples of irregular shape can be satisfactorily treated without special arrangements. Parts in contact with other metals, however, cannot be treated, and the process must be used prior to the assemblage. Further, there may at times be difficulties as a result of the insulating properties of the film where good electrical contact is required. Electrolytic coatings of zinc and cadmium 0.0005 in. thick afford good protection to the metal and its alloys with the exception of cadmium on aluminium itself. Nickel coatings of the same thickness, however, were found not to give adequate protection.

CATALYST POISONING IN THE OXIDATION OF METHYL-ALCOHOL. The Chemiker-Zeitung of Oct. 12 contains an account of some investigations into the eauses of catalyst poisoning in the oxidation of methyl-alcohol to formaldehyde. Since poisoning has been found to be due to a considerable extent to impurities in the air supply, it is advisable to draw pure air from an area quite outside the range of factory products. The cost of the necessary installation is rapidly counterbalanced by the increased yield, which under good conditions has been found to amount to 92 per cent, of the theoretical value and to be easily maintained at that figure.

AN OXIDE OF FLUORINE.—No compound of fluorine and oxygon has hitherto been described, and hence the communication by Messrs. P. Lebeau and A. Damiens m the Comptes rendus of the Paris Academy of Sciences for Oct. 3, demonstrating the existence of such a compound, will arouse considerable interest. In the preparation of fluorine by the electrolysis of acid potassium fluoride, it was noticed that at the commencement of the operation some substance other than fluorine was present, and the cause of this was traced to the presence in the liquid of a small quantity of water. The new gas has not been obtained pure, but only in admixture with oxygen. From the density of the mixture and the chemical reactions, the formula of the gas has been established as F<sub>2</sub>O, and it is noteworthy that it is more stable towards a rise of temperature than the corresponding chlorine compound, Cl<sub>2</sub>O, since it remains unaltered when heated to 125° C. in contact with glass. It can also be kept unchanged for several days m contact with water and glass. With alkalies it forms fluorides, setting free oxygen; free iodine is produced by interaction with potassium iodide.

## Across Canada with Princeton.

The Princeton 'Summer School of Geology and Natural Resources,' led and organised by Prof. R. M. Field, has completed its second annual excursion. We started from Princeton on July 15 and returned on Aug 24. Meanwhile, we traversed and retraversed the North American continent by routes that very seldom intersected. Except for two nights on the steamer between Vancouver and Victoria, we slept on the Pullman that bears the arms of the School. This car has been specially constructed with kitchen, shower-bath, lecture-lantern, screen, etc. Most of our travelling was done at night, to leave the days free for geology. Of twenty-five main halts, one at Bellefonte introduced us to the Pennsylvanian Appalachians and another to the southern side of the Niagara gorge, the rest were in Canada. Last year's trip was wholly in the United States. Next year's is planned for intensive study of the Appalachians. For 1929, there is talk of a motor-car raid upon Scotland and Switzerland.

This Summer School is interesting as typical of modern America. In Europe it would be unthinkable In America, at the present time, if a project is original, striking, and 'worth while,' it can be achieved British readers will grasp the scope of the Princeton organisation when they find the Director of the Geological Survey of Great Britain among the eighteen members of Council. Of the others, two are Canadian, while a third of the total are acknowledged leaders in

the world of transport.

Obviously, the success of the undertaking depends equally upon transport and guidance. Railway facilities were supplemented by motor-cars and occasionally by steamers; and it is characteristic of the lavish hospitality of the land that the motorcars were in many cases supplied by well-wishers whose names even we cannot hope to remember. The indispensable guides were arranged for by the Director of the Geological Survey of Canada, by the Universities of Toronto, Winnipeg, Vancouver, and Harvard, and by various mining companies and private individuals. Our debt to them is fundamental, and it is proper to pay tribute to the glorious freedom of discussion which was extended to us wherever we went.

Two important motifs have actuated Prof. Field in bringing this wonderful Summer School into existence. He wished to arrange for an annual international congress of comparative geology and to have it itended by young and old together. It is part of the constitution that every year a citizen of the British Commonwealth and another from the outside world shall be invited as guests. On the present occasion, I had the great good fortune of accompanying my old friend, Prof. L. W. Collet, of Geneva, across the Atlantic to learn far more than we had even dared to hope. The party, all told, was twenty-seven men, ranging from professors to undergraduates. The interest of the latter was strengthened by the thought of an examination at the end of the course, and from their questions we others learnt many a lesson.

Perhaps, as British 'observer,' I may be permitted to record some of the impressions of the trip. In the first place, the North American Continent is, broadly speaking, a magnified mirror image of much of Europe. North America has three major divisions: (1) an Atlantic border of Palæozoic mountains (Appalachian System); (2) an immense central region (Laurentia of Suess) that has suffered no mountain-making deformation since the dawn

of the Cambrian; and (3) a Pacific Cordillera (Rocky Mountains, etc.) characterised by Mesozoic and Tertiary compression Both the Atlantic and Pacific mountains have been folded and thrust over the maigins of the intervening stable element. The latter is seldom spoken of as Laurentia, but its main pre-Cambrian exposure is familiarly styled the Canadian Shield, while its Cambrian and later systems are for the most part included in the Great Plains If now we turn to Europe, we find: (1) a Palæozoic border chain that runs through Scandinavia and Britam; (2) a central region that we may christen Baltica, a region of Cambrian and post-Cambrian tranquility, and (3) a Mesozoic-Tertiary cordillera (Carpathians, Crimea, Caucasus). Here again the mountain elements (1) and (3) are folded and thrust upon the margins of the buffer state (2) in the latter we find a Baltic Shield to match the Canadian Shield, and a Russian Platform, extending through Denmark into East Anglia, to serve as counterpart of the Great Plains of North America.

The pivot of our comparison is furnished by the mountain chain of Scandinavia. This chain is markedly symmetrical. On one side, in Sweden, it is carried forward along the Tornebohm thrust-zone on to undisturbed early Palæozoic rocks of Baltica. On the other side, as exposed in the north-west Highlands, it has travelled along the Moine thrust-zone on to undisturbed early Palæozoic rocks recognised by Suess as part of Laurentia. Across the Atlantic, the Scotto-Scandinavian mountains reappear in Newfoundland and Nova Scotia, and the Moine thrust-zone is represented by the well-known dislocation-belt of St. Lawrence and Lake

Champlain

Beyond this point the reader must proceed warily. It is only a part of the Appalachian System that corresponds with the Scotto-Scandinavian chain The Appalachian System is a complex of two of the important mountain systems of Europe. In fact, the geology of the Atlantic States of North America is summarised in the words: Where mountains cross.

Let us join Marcel Bertrand's pupils and define for tectonic purposes Calcdonian as meaning early Palæozoic, Hercynian as late Palæozoic, and Alpine as Mesozoic and Tertiary. Bertrand, after reading Dana in 1887, recognised part of the Canadian and New England Mountains of the Appalachian System as Caledonian, while he separated the Pennsylvanian Appalachians as Hercynian. The data have been greatly clarified of recent years, and the progress of knowledge as presented by authors like Clark (1921), Collins (1924), and Young (1926) has immensely strengthened Bertrand's comparisons with Europe. Young's account is particularly explicit. "Before the close of the Devonian period," he says, speaking of the eastern mountains of Canada, their strata "were folded and faulted, and invaded by granite batholiths" (Geol. and Econ. Mins. Can., p. 89; 1926). In Pennsylvania, of course, the folding is post-Carboniferous.

Many thoughts spring to the mind of the European geologist who finds himself standing in Pennsylvania on Hercynian mountains outside the line of the type

Caledonian chain.

(1) The westward convergence of the two Palæozoic chains—so far apart in Poland and Lapland, already in contact in South Wales and Ireland—has led to their actual crossing in the United States.

(2) Not only have the mountains crossed, but also the stratigraphy. In Pennsylvania there is an immense concordant succession from Cambrian to Carboniferous. In the anticlines we find our Durness Limestone (Beekmantown) as if we still stood in the north-west Highlands of Scotland. In the synclines we discover Upper Carboniferous Coal Measures (Pennsylvanian) derived from the waste of a growing Hereynian chain, and our thoughts are transferred at once to South Wales, the Ruhr, and Poland.

(3) In much of the Canadian part of the Appalachian System, a lunestone facies within the Lower Carboniferous serves as a punctuation mark between Caledonian and Hercynian movements, just as it does in the British Islos and in Belgium.

(4) It is as if the Atlantic did not exist or, in other words, as if Wegener, after all, were a true prophet.

and Potsdam sandstones (Upper Cambrian), in a post-Potsdam sandstone near Ottawa (Lower Ordovician), in the St. Peters and Winnipeg sandstones (Middle Ordovician), and in the basal Trenton limestone at Montmorency Falls, Quebec (also Middle Ordovician). There is a sufficiently close analogy between all this and the chalk and desert-sand association of the Franco-British Cretaceous (Geol. Mag., p. 102; 1924). The Cambrian to Middle Ordovician deposits of Laurentia may be interpreted as having accumulated in a warm shallow sea that bathed the shores of a low desert continent. The same facies extends into the Pennsylvanian Appalachians, where the carbonate rocks may reach as much as 8000 ft. in thickness. It is called the

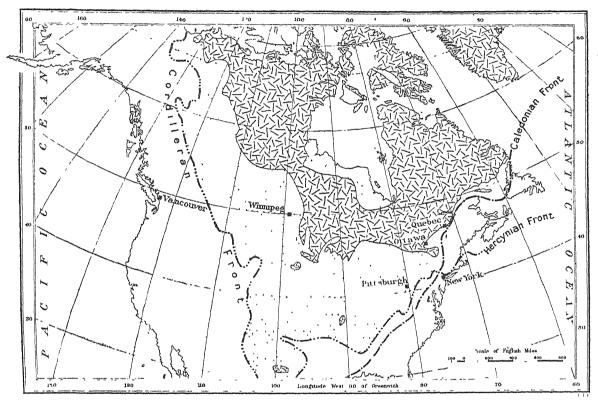


FIG 1—Tectome map of North America. The interior region (Laurentia of Suess) has remained unaffected by mountain tolding since pre-Cambrian times. Its pre-Cambrian outcrops are shown by strokes, its Gambrian and later by stipple. Modified after M. Bertrand (1887), Bailey Willis and G. W. Stose (1911), E. Blackwelder (1912), W. H. Collins (1924), G. A. Young (1926)

The thrust-zone of St. Lawrence has been mentioned as a continuation of the Moine thrust-zone of the north-west Highlands. Its interest is intensified by the fact that the thrusts have involved a transport of facies comparable with that so famous in the Alps. This last point is clearly set out in Raymond's guide for the 1913 International. Collet and I were able to add details here and there, simplifying the mapped course of certain thrusts, complicating others by recognition of successive slices—but this has only increased the charm of the story.

According to plan, the excursion maintained frequent contact with Ordovician rocks so far east as Winnipeg. The Cambrian to Middle Ordovician facies of Laurentia differs profoundly from that of the Caledonian Atlantic border. In the former district, one finds a wealth of pure carbonate rocks (marine limestones and dolomites), and there is little contamination except for wind-rounded sand. Such sand is represented, for example, in the Croixian

American facies; and in our own country it has long been recognised as characteristic of the Durness succession of the north-west Highlands.

The Caledonian facies is, on the other hand, commonly spoken of as Atlantic, British, or European. It consists of muds and sands, washed down by rivers from the ram-swept heights of the growing Caledonian chain. Its fossils are graptolites, and other creatures, including species familiar in Wales, southern Scotland, and Scandinavia

Conglomerates or breceias, varying in age from Cambrian to Middle Ordovician, are frequent in Canada and the northern States along the frontal part of the Caledonian chain. They are often interbedded among shales of British facies, but their boulders are mostly limestones of American facies. These boulders are fossiliferous; and while many of them are about the same age as the associated shales, others are distinctly older—for example, Cambrian boulders frequently occur in breceias

interbedded among Ordovician shales. The matrix, too, of every breccia that we examined near Quebec contains quartz sand that is absent from the accompanying shales. Altogether, there can be no doubt that these breccias have been correctly determined as sedimentary deposits Exceptionally, a bed of breecia contains, or at any rate accompanies, a mass of lunestone so large that the tendency has been to interpret it as a relic of a bed still in situ. One such limestone mass, in a quarry near Lévis, opposite Quebec, measures 60 ft. in length and 30 ft. in height. Collet and I returned to this exposure after the excursion was over. We satisfied ourselves that the mass had ploughed into the underlying shales and splattered them through the accompanying breccia. We felt that we were looking at a sub-marine landship that had travelled down a steep slope subject to earthquakes; and standing there we thought of Schardt and of his interpretation of the blocs exotiques of the Alpine Tertiary. The comparison, however, must not be pushed too far, since at Lévis the boulders are of foreland rather than of mountain facies. It is extremely interesting that one has to travel hundreds of miles to match the material of these boulders at the outcrop It seems necessary to accept Raymond's suggestion that their source is hidden under overthrusts.

Space forbids more than a mention of our visit to Niagara, to the vent agglomerates associated with the peridotites of Quebec, to the Pleistocene inter-glacial beds near Toronto, to the pre-Cambrian glacial beds at Cobalt, to the flat pre-Cambrian of Port Arthur and Fort William on Lake Superior, to the Keewatin and other folded pre-Cambrian forma-tions of the same region, Ramy Lake and Porcupine, to the late Glacial lakes that drained to the Mississippi and New York while ice blocked escape to Hudson Bay and the St Lawrence, to the Tuner Oil Field on the first anticline of the foothills of the Rockies. In the Rockies themselves, thanks to our guides, Kindle, Mackay, and Raymond, we saw thrust after thrust in the districts of Jasper and Banff. We also examined, near Walcott's famous fossil quarry above Field, a spectacular example of secondary doloinitisation In a cliff face, showing horizontal bedding, an abrupt wavy line runs nearly vertical for several hundreds of feet and separates black limestone from pale buff dolomite. As the bedding goes through the line without any change, it is clear that the dolomitisation has been affected by circulating magnesian solutions. I can only suggest that the portion which has remained limestone was, at the critical time, charged with oil.

of the metrior Plateaux of the Cordillera we saw gramte intruded into folded Tertiary tuffs at Copper Creek, Lake Kamloops—so far as we know, a new observation. At Vancouver we were shown the

great post-Jurassic granodiorite of the Coast Range, with late Eocene conglomerates and sands overlying its weathered top. In Victoria we were particularly interested in a complicated thrust-zone that brings (?) Carboniferous slates over Eocene pillow lavas.

A few words must be added regarding Sudbury, Ontario. Here an elliptical annular outcrop of plutonic igneous rocks surrounds an exposure of the pre-Cambrian White Water Series of sediments, an exposure that measures no less than 34 miles in length and 11 miles in breadth. The igneous girdle varies from 1 to 4 miles in width. The outside country consists of a pre-White Water complex. According to the orthodox reading, the igneous rocks of Sudbury were intruded flatly as a sill along the unconformable bottom of the White Water Series, and then the whole was bent into a basin. Knight, however, in 1917, pointed out that a sill of such extent would surely show transgressive relations. Since no trace of the White Water Series has been found anywhere along the outer boundary of the Sudbury intrusion, Knight interprets this sedimentary series as preserved within a cauldron-subsidence and the intrusive girdle as a ring-dyke. He was delighted to hear that similar phenomena on a smaller scale have been fully established in both Scotland and Norway during the last twenty years — It is scarcely necessary to point out that those who accept Knight's interpretation must dispense with the particular gravitational differentiation hypotheses that have grown out of the sill conception of Sudbury structure. These hypotheses have been much criticised on quite other grounds.

The advantage of international comparisons was further illustrated by the recognition of 'finity crush-rock' at Harvard, and by Tanton's demonstration to us of Grout's principle (Bull. Geol. Soc. Am., 36, fig. 5, p. 358; 1925) for elucidating the order of deposition of folded strata. This rather elusive principle was independently employed in an isolated case in the Scottish Highlands in 1913, but there now seems hope of its fairly frequent application—in which case extremely important discoveries are certain to result.

The account given is unrepresentative, in that it has not touched upon economic problems. This is merely due to consideration of space. The gold of Porcupine and Hedley, the silver of Cobalt, the nickel of Sudbury, the asbestos and chromite of Black Lake, the coal of Brule, and the oil of Turner Valley were all examined with the greatest interest, and time was found at Port Arthur, Iroquois Falls, and Vancouver to watch timber ground into pulp or sliced into planks. For a Britisher, it was certainly an inspiring sight to see the new 4000 ft shaft in the Porcupine gold field entirely equipped with English machinery.

E. B. Balley.

#### The Storage of Fruit.

I T is estimated that in 1924 the value of the fruit and vegetables consumed in Great Britain approximated to £100,000,000, imported fruit accounting for nearly half of this figure. The importance of this industry, with its especial hability to wastage of the products dealt with, is sufficient justification for researches into the factors which affect the keeping qualities of fruit and vegetables, apart from the purely scientific interest of such investigations. In its Report for the years 1925 and 1926 the Food Investigation Board describes the results of a number

 $^1$  Department of Scientific and Industrial Research. Report of the Food Investigation Board for the years 1925, 1926  $\,$  Pp vi+80+2 plates (London II M. Stationery Office, 1927)  $\,$  2s. 6d. net.

of researches into the various factors favouring or preventing deterioration of fruit on storage, the work including both chemical studies of apples and pears of different types during ripening and storage as well as investigations into the suitability of various kinds of store.

In the case of apples, and the conclusion is presumably applicable to similar types of fruit, it has been found that the best keeping varieties contain the least nitrogen and the most sugar, and exhibit the lowest respiratory activity. The inference is that the life-expectation of gathered fruit depends upon the amount of living protoplasm it contains and upon the extent of the accumulated sugar

reserves · death ensues when the sugar available for combustion is exhausted, and this occurs the earlier the larger the amount of protoplasm present ing with Bramley's Seedling apples from three different soils, F. Kidd and C West have shown that the nature of the soil has a marked influence on the nitrogen content of the fruit, and hence on its keeping quality In general, specimens from silt soil survive much longer than those from fen or gravel soil, at storage temperatures of both 1° C and 8° C At about the latter temperature it was found possible to double the storage life by storing in an atmosphere of 9.2 per cent. carbon dioxide and 11.8 per cent oxygen instead of in air The apples from the silt soil have a low nitrogen content but a high sucrose content, those from fenland a high nitrogen and a low sucrose content, whilst those from gravel have a low content of both constituents: their keeping qualities agree with the inference given above that the life of an apple depends on the demands the living protoplasm makes upon the sugar stores The latter and the acid present in the fruit appear to be the sole source of respirable material. Death of the fruit stored at 1° C is accompanied by a browning of the flesh, a condition known as 'internal breakdown'. in its early stages, its respiration is increased whilst the acidity decreases rapidly; but in the final stage all respiration ceases. Stored at 8° C., wastage is caused by disease, 'fungal rot,' and not by internal breakdown.

The chemical changes occurring in fruit on storage are not exactly the same in different types: thus although the respiratory processes of pears as well as apples depend on the sucrose and acid content, yet the softening occurring on ripening and storage, due to breakdown of the cell-wall and loss of pectin, is much more rapid in pears stored at 12° C, and 4° C, although at 1° C. the process is less retarded in the apple (A. M. Emmott). Caution must then be exercised in applying the knowledge obtained from experments on one type of fruit to another optimum storage conditions will vary slightly from fruit to fruit and even from one type of the same fruit to another, although certain general principles will doubtless hold good in the majority of cases. This is well exemplified by an investigation of the same authors into the efficiency of different types of store, in which they found that variety plays an important part in the determination of optimum storage conditions. Thus the Newton Wonder, which is very resistant to internal breakdown, has a longer storage life the lower the temperature, at any rate to 30° F., whilst the King Pippin, very susceptible to this form of deterioration, stores best at 40° F. When the storage life is ended by 'superficial scald,' and not by 'internal breakdown,' wrapping the fruit in oiled paper wrappers has a marked effect in prolonging it.

The problems of storage as affecting ships have been investigated by A. J. M. Smith. The chief difficulty is to obtain an efficient equalisation of temperature throughout the fruit, even when air is forced through the cargo. The simplest plan appears to be to apply the refrigeration at the top of the cargo, which is so arranged as to have vertical air spaces between the cases of fruit: in this way the distance to be travelled by the cold air is minimised and full advantage taken of its gravitational tendency to

move downwards.

This brief account gives an insight into the type of work carried out by the Food Investigation Board. The ultimate result of these and similar researches is clearly to improve the food supply of a nation which relies for the major part on food products brought from overseas.

## The Centenary of Berthelot.

MARCELLIN BERTHELOT was born in Paris on Oct. 25, 1827, and the centenary of his birth was celebrated by a series of sumptuous functions and by the inauguration of an enterprise which is to form a permanent memorial to one of the most eminent of the French chemists. For some time past committees have been in course of formation throughout France and in some sixty foreign countries for the collection of the funds required for carrying out a scheme for erecting and endowing in Paris a Maison de la Chimic associated with the name of Berthelot, the sum of about sixteen million francs has been thus collected and, during last week, some six hundred foreign delegates assembled in Paris to take part in the celebration of the centenary.

The proceedings began with a reception at the Sorbonne on the evening of Sunday, Oct 23, by M Charléty, the rector of the University of Paris. On Monday morning, in the presence of representatives of the French Government, a museum of apparatus and manuscripts relating to Berthelot was opened at the Faculty of Pharmacy by Prof. Radet; the visitors were next received at the Collège de France by M. Croizet; after speeches by the president of the German Chemical Society, Prof. Schlenk, and Prof. Bogert, of Columbia University. Berthelot's former laboratories and apparatus were inspected. Later, a memorial tablet was unveiled on the wall of Berthelot's early residence, 113 Rue Saint Martin, and speeches were made by M. Boujou, Préfet de la

Seine.

The chief meeting was held in the large amphitheatre of the Sorbonne on the evening of Oct 24; discourses were pronounced by Prof. Ch. Moureu on the work of Beithelot, and by Prof. Lacroix, secretary of the Academy of Sciences; M. Georges Lecomte,

director of the Académie française; M. Gley, president of the Academy of Medicine, M. Wéry, president of the Academy of Agriculture; M. Hodza, Minister of Education for Czechoslovakia; and by M. Paul Pamleyé. Addresses were presented on behalf of numerous academic bodies, it is indicative of the widespread interest in the celebration that the first

addresses handed in were those from Abyssinia and Alghanistan.  $\,$ 

A commemoration ceremony took place at the Pauthéon on Tuesday morning, Oct. 25, when speeches were made by M Raymond Poincaré, and by M. Galhardo, Minister of Foreign Affairs of the Argentine Republic. This was followed by a lunch in the Galérie des Batailles at Versailles, which was attended by some 1200 guests, and discourses were delivered by M. Herriot, Minister of Education; Prof. Amé Pietet, of the University of Geneva, and M. Lunatcharsky, Minister of Education to the Union of Socialist Soviet Republics.

On Wednesday morning, Oct. 26, the foundationstone of the new House of Chemistry was laid in the Place d'Iéna by M. Herriot; M. Donat-Agache, president of the French Society of Chemical Industry; M. Zumeta, the Venezuelan Minister; and Prof. Ernst Cohen, of Utrecht, spoke, and the party adjourned for lunch to the Château belonging to the French Academy at Chantilly, where discourses were pronounced by M. Leconte, director of the French Academy, and Prof. H. E. Armstrong. In the evening the delegates were received by the President of the Republic, M. Gaston Doumergue, at the Palais de l'Elysée.

It is proposed to issue a commemorative volume giving a full account of the proceedings of the Borthelot centenary celebrations. W. J. P.

## University and Educational Intelligence.

Cambridge - -Dr. Ernest Clarke has been elected to an honorary fellowship at Downing College. Mr V. B. Wigglesworth, Gonville and Caius College, has been awarded the Raymond Horton-Smith Prize for a thesis, "Studies on Ketosis: with special Reference to the Relation between Alkalosis and Ketosis" Proxime accessit, Dr. A. E. Roche, Magdalene College, with a thesis on "Pyelography, its History, Technique, Uses, and Dangers." D. Barber, Trinity College, has been awarded the Adam Smith Prize for an essay on "The International Aspect of Wages" Miss A. McC. Bidder, Newnham College, has been nominated to the University table at the Zoological station at Naples for three months from Feb. 15, 1928.

The managers of the Arnold Gerstenberg studentship in philosophy have issued an interesting list from which candidates may select an essay subject: they are, "The ultimate data of physics, philosophical aspects of the theory of relativity, the philosophical bearings of the quantum theory, technical explanation and the problems of biology, heredity, and memory, Gestalt-psychology, and the logical basis of induction."

N. Feather, H. J. J. Braddick, and N. A. de Bruyne

N. Feather, H. J. J. Braddick, and N. A. de Bruyne have been elected to Coutts Trotter studentships at Trinity College.

OXFORD —Sir Archibald Garrod has tendered his resignation of the office of Regius professor of medicine as from Dec. 31 next. Sir Archibald succeeded Sir William Osler in 1920.

The Burdett-Courts Scholarship for geology has been awarded to Mr. Partick Murray Threipland, of Christ Church.

Mr. John Mason has been elected to a Fereday fellowship at St. John's College, under the obligation of pursuing a special course of research in natural science. Mr. Mason has been engaged in research work on chemical bacteriology under Dr. Ashley Cooper at Birmingham.

A research followship in natural science and a lectureship in chemistry are being offered at Exeter College. The elections will be made on Dec 12.

The following appointments have been made at the London School of Hygiene and Tropical Medicine: Mr. Reginald Lovell, research assistant in comparative pathology. Mrs. M. M. Smith, demonstrator in bacteriology, Miss H. M. Woods, assistant lecturer in epidemiology and vital statistics.

The following free public lectures have been arranged for by the Armourers and Brasiers' Company: "X-rays and Metals," by Dr. G. Shearer, at the Royal School of Mines, at 5.15 on Nov. 8, 15, and 22, "The Deformation of Metals," by Prof C. H. Desch, at the Chelsea Polytechnic, at 8 on Nov. 30, Dec 7 and 14.

Mr. George Fletcher, who since 1904 has been assistant secretary of the Technical Instruction Branch of the Department of Education, Dublin, has just retired from that post. He has rendered valuable service to educational science throughout his career, and takes with him the best wishes of many friends both in England and in Ireland.

The North of Scotland College of Agriculture announces in its prospectus for 1927–28 university degree courses in agriculture, national diploma courses in agriculture and in dairying, a special farmers' course (one winter), and a planters' certificate course (two winters and one summer). The last-mentioned is designed as a preparation for service on estates in tropical and sub-tropical countries. Research is being carried on by mombers of the college staff in soils and dramage and in bee diseases.

## Calendar of Discovery and Invention.

November 7, 1631 —The first observed transit of Mercury took place on Nov. 7, 1631—It had been predicted by Kepler and was observed at Paris by Gassendi, who admitted the solar light into a dark chamber through a small aperture in a window

November 7, 1857.—In a letter of this date, Helmholtz, writing to the oculist Graefe, described the ophthalmoscope Of the discovery Lummer wrote "He wondered at the glare of the cat's eyes in the darkness, and studied this curious phenomenon until he learned how the light enters the eyes and is returned from the retina in such a way that it may be observed. Thus he became the inventor of the ophthalmoscope... and thus all our technical industries profit by the original research of investigators who are not inspired by dreams of wealth, but who must think and work in order to satisfy their inquiring natures."

November 8, 1887.—The invention of the gramophone was due to Emile Berliner and was patented by him on Nov. 8, 1887. The essential difference between the gramophone and phonograph is that in the former the engraving tool vibrates from side to side, while in the phonograph Edison employed the 'hill and dale' method. Berliner was born in Hanover in 1857, but emigrated to the United States in 1870 and played a conspicuous part in the development of the telephone.

November 8, 1907.—The art of telegraphing pictures with the aid of selenium cells was developed by Prof Korn, of Berlin, in 1904, and on Nov 8, 1907, he transmitted photographs electrically between Paris and London.

November 10, 1619.—Descartes in 1617, at the age of twenty-one, joined the army of Prince Maurice of Orange, and the following year, at the commencement of the Thirty Years' Wai, volunteered for service in the Army of Bavaria. However, he continued his mathematical studies and was afterwards accustomed to date the first ideas of his new philosophy and of his analytical geometry from three dreams which he experienced on the night of Nov. 10, 1619, when bivouacked at Neuberg on the Danube. He regarded this as the critical day of his life, and one which determined his whole future.

November 10, 1845.—Leverner's investigations leading to the discovery of Neptune were contained in three memoirs communicated to the Paris Academy of Sciences on Nov. 10, 1845, June 1, 1846, and Aug. 31, 1846, respectively. In the first he proved the inadequacy of all known disturbances to account for the vagaries of Uranus; in the second he demonstrated that the observed effects must be due to an exterior planet; and in the third he assigned the orbit of the disturbing body, and announced its visibility as an object with a sensible disc about as bright as a star of the eighth magnitude

November 11, 1572.—It was on Nov. 11, 1572, that Tycho Brahe discovered in Cassiopeia a new star of great brilliance. At first refusing to believe his own eyes, he got others to confirm what he saw, and continued to observe the star until the end of January 1573. He made accurate observations of its distance from the nine principal stars in Cassiopeia, and proved that it had no measurable parallax. His researches on this object were the occasion of his first appearance as an author.

November 12, 1906.—Three years after the Wright brothers had flown in America, success was achieved in Europe by the Brazilian, Santos Diumont, who first flew on Aug. 22, 1906, and also on Nov. 12, 1906, at Bagatelle, travelled a distance of 100 metres.

E. C. S.

## Societies and Academies.

#### EDINBURGH.

Royal Physical Society, Oct. 17 – J. Stephenson Eastern adepts and Western science —A. C. Chaudhuri A study on the pigmentation of the Himalayan rabbit. By controlling the temperature of the environment, Himalayan rabbits can be made to grow pigmented hair in place of white. Low temperature probably stimulates the epithelial cells of the follicles to secrete an oxidase which in combination with a chronogen produces the pigment granules — P. McIsaac Blood serum calcium and parturition in the rabbit. Seven to ten days before parturition in the rabbit there is a fall in the serum calcium content, and one day before parturition there is a further and sudden fall to a minimum. After parturition the calcium content is restored to normality, but on the numeteenth day or thereabouts of the lactation period there is a second sudden fall.

#### MANCHESTER.

Literary and Philosophical Society, Oct. 4.—E. J. Williams. The number of Compton recoil electrons. Comparison of the observed values of the ratio  $N_r/N_p$ , where  $N_r$  and  $N_p$  are the numbers of 'Compton' electrons and the photo-electrons respectively, with the corresponding observed values of the ratio  $\sigma_m/\tau$  where  $\sigma_m$  and  $\tau$  are the coefficients of 'modified' scattering and photoelectric absorption respectively, shows that to within a few per cent. (which can be due to experimental error) the theoretical assumption of a one-to-one correspondence between the 'Compton' electrons and the modified scattered quanta is valid —at least statistically. It we assume the absolute validity of this assumption,  $\tau N_r/N_p$  and  $\sigma_m$  are identical quantities, and the values of  $\tau N_r/N_p$  can be regarded as experimental values of  $\sigma_m$ . A. J. Bradley and C. H. Gregory. The structure of certain ternary alloys. Copper and zinc form five different kinds of alloy, known respectively as the  $a, \beta, \gamma, \epsilon$ , and  $\eta$  phases; the  $\alpha$  phase has a face-centred structure like copper,  $\beta\text{-brass}$  is body-centred cubic,  $\gamma\text{-brass}$ has a remarkably complex cubic structure. It consists essentially of four atom types A, B, C, D, combined in proportions corresponding to the formula  $A_2$   $B_2$   $C_3$   $D_6$ . On the whole, B and C atoms are copper atoms, A and D atoms zinc, but the atoms are not completely sorted out, and there is usually a surplus of zinc atoms. In view of the similarity between the  $\gamma$  phase of copper-zmc and the  $\gamma$  phase of copper-aluminium it was decided to test the possibility of forming mixed crystals of the two phases Alloys corresponding to the formulæ Cu<sub>5</sub> Zn<sub>5</sub> and Cu<sub>5</sub> Al<sub>4</sub> were made up and were then melted together in different proportions. Three such alloys were thus made up, and the structures in each case were identical with the structures of the binary alloys; the alloys were quite homogeneous in character The similarity between these different structures is independent of the chemical composition but is closely related to the electron distribution is in each case the same ratio of valency electrons to atoms, namely, 21:13.

#### Paris.

Academy of Sciences, Sept. 26.—A Lacroix and F. Delhaye. The existence of nephelime syemies in Rutshuru region (Central Africa).—G Urbain and Pulin Bihari Sarkar. The analogies of scandium with the elements of the rare earths and with the trivalent elements of the iron family. The resemblances between scandium and the rare earths are

mainly analytical; even from this restricted point of view, scandium most resembles thorium, in spite of the difference in the valencies. The study of the acetylacetonates, the complex fluorides and thioevanates all show the close relations between scandium and the trivalent metals of the iron group —Jacques Chokhate: Mechanical quadratures and the zeros of Tchebycheff in an infinite interval. - Henry de Laszlo: The absorption of the ultra-violet rays by the ten isomers of dichlornaphthalene. The positions and intensities of the absorption bands of the ten dichlornaphthalenes are given in tabular form—E Bruet. The upper Phocene of the Aujon valley—F. Bordas and A Desfemmes The distribution and transport of chlorides in the atmosphere. From analyses of ram water at places at different distances from the sea, it is concluded that the atmosphere may carry m suspension quantities of chlorides which, carried down by rain, represent a fall of 8.41 grams of sodium chloride per square metre. These chlorides may be carried much greater distances inland than has been admitted hitherto .- J. Dumont: The influence of prolonged cultivation without manure on the nitrogenous richness of the soil: A continuation of the work of P. P. Dehéram. The mtrogen losses found, which are in agreement with the earlier results of Dehéram, are small and can be rendered insignificant by the periodic cultivation of a leguminous crop -Pierre P Grassé and Mile Odette Tuzet: The chromatic rod and the head of spermatozoids - Raymond-Hamet: The influence of yohimbine on the intestinal action of adrenaline and of ouabaine -L. Barthe and E Dufilho: The estimation of chlorine and of sodium in the milks of some mainmalian females. In human milk, and also in that from marcs, the chloring found does not correspond with the sodium directly determined, calculation of the sodium from the chlorine gives altogether erroneous results. The chlorine varies with the period of lactation and reaches a minimum value on about the sixteenth day. Sodium is present in negligible quantity up to the forty-fifth day, and hence is probably not required by the newly-born, -Swigel and Theodore Posternak: The nucleus containing phosphorus of ovovitelline. A quantitative analysis of the products of hydrolysis of  $\beta$ -ovotyrine is given, including phosphoric acid, pyruvic acid, ammonia, arginine, Instiduce, lysine, and t-serin, the amount of the lastnamed being 28 per cent. of the original material.-Kohn-Abrest: Atmospheric diffusion of the smoke of Paris. Samples of air were taken simultaneously on the Eiffel Tower at heights 0, 57, 115, and 288 metres above the ground. The results of the determinations of carbon monoxide and dioxide are given. The purity of the air does not increase with the height, as might have been expected. - Jules Amar: The parasitic origin of cancer. The facts summarised by the author all support the parasite theory of cancer.—F Dienert and P Etrillard: The action of free chlorine upon micro-organisms. Determinations of the amounts of free chlorine per litre required to sterilise nine species of organisms. The proportions required vary from 0.1 mgm, per litre to 8 mgm, per litre. The results appear to be best explained by the chemical theory of Barker.

#### VIENNA.

Academy of Sciences, July 7.—It. M. Exner: The dependence of the turbulence factor of the wind on the vertical distribution of temperature. Theories founded on observations at the Effel Tower.—M Kohn and H Karlin: (1) Dibromo-o-amisidin and tribromo-o-amisidin (28th communication on bromophenols). (2) A molecular transformation accom-

panying the formation of tubromo-o-amsidin from o-nitroanisol (29th communication on bromophenols) -H. Swiatkowski and J. Zellner · Contributions to comparative plant chemistry (18). Carex flacca This plant contains more fat and protein in its seeds but less starch than other Grammer.—J. Zellner and others (19). Chemistry of barks. Salix purpurea, Robinia Pseudacacia and Ceratoma siliqua contain ceryl alcohol and other substances—E. Huppert, H Swiatkowski, and J Zellner. (20) Chemistry of laticiterous plants—N. Froschi and P Bomberg. The representation of proto-catechu-aldehyde and of vanilin —A Kailan and L Lipkin. The velocity of esterification of nitro-benzoic acid in glycerme. An equation is given.—E. Haschek. Quantitative relations in the theory of colours -A. Smekal. The behaviour of the ions of insulating crystals in electric fields. Electric strains in the crystal lattice work produce alterations in the distance apart of the ions comparable to mechanical strains. The work of other experimenters on the spongy structure of crystals has been followed up by experiments on rock-salt.-H Raudnitz. Communication from the Institute for Radium Research, No. 207. Contributions to the electrolysis of radio-active B- and C-products and of polonium.—A. Skrabal and A. Zahorka: The kinetics of saponification of vinyl acetate —F. Heritsch. The coal of the Karnatic Alps and of the Karawanken

## Official Publications Received.

Journal of the Royal Statistical Society Vol. 90, Part 4, 1927. Pp x+637-842+vin (London) 7s bil Aquicultural Economics in the Empire. Report of a Committee appointed by the Empire Marketing Board.)

Transactions and Proceedings of the New Zealand Institute Vol. 58, Parts 1, 2, Margh 1982, 198

Transactions and Proceedings of the New Zealand Institute Vol. 58, Parts 1, 2, March, June Pp 1v+188+20 plates (Wellington, N Z) New Zealand Dominion Museum Bulletin No o The Pa Maori, an Account of the Fortified Villages of the Maori in Pre-European and Modern Times, illustrating Methods of Defence by means of Ramparts, Fosses, Scarps and Stockades By Elsdon Best Pp viii+339 (Wellington, N Z) Scottish Mainie Biological Association. Annual Report 1026-27 Pp 21 (Glasgow)

Commemoration of Armistice Day: an Order for Service (Prepared for Use in Schools) Pp 8 (Cardiff National Council of Music, Welsh League of Nations Union, London Oxford University Press) 1d. The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 55, No 370, October Pp. 913-976+xvin. (London University College of Wales, Aberystwyth Welsh Plant Breeding Station Red Clover Investigations By R. D. Williams (Series H, No 7, Seasons 1919-1926.) Pp 136-111 plates (Aberystwyth) 58 (Glasgow)

#### FOREIGN.

Foreign.

Department of Commerce Bureau of Standards Scientific Papers of the Bureau of Standards, No. 550 Current Distribution in Supracion ductors. By F B Sulsbee Pp. 203-314 10 cents. Scientific Papers of the Bureau of Standards, No. 557 A suggested new Base Point on the Thermometric Scale and the a \( \infty \) 315 317. 5 cents. (Washington, D C Government Printing Office.)

Wiscousin Geological and Natural History Survey. Bulletin No. 68, Soil Series, No. 19. Soils of Wiscousin, By Prof. A. R. Whitson, Pp. Mi-270 | 32 plates, (Madison, Wis)

Proceedings of the United States National Museum Vol. 71, Art. 17. The Maskell Species of Scale Insects of the Sublamily Asterolecaning By Harold Morrison and Emily Morrison (No. 2689) Pp. 67+29 plates (Washington, D C. Government Printing Office)

Journal of the Farcilty of Agriculture, Hokkado Imperial University, Supporo, Japan Vol. 21, Part I. Staders on the Melampsoraceae of Japan. By Naohide Hiratsuka. Pp. 41. (Tokyo Maruzen Co., Ltd.)

Proceedings of the Imperial Academy. Vol. 3, No. 7, July. Pp. Nilemmin State States National Museum Vol. 71, Art. 15. On Fossil Turlies from the Pleisticene of Florida. By Charles W. Gilmore (No. 2687) Pp. 10+5 plates (Washington, D.C. Government Printing Office)

#### CATALOGUES

Elektro-physikalische Lehrmittel Pp 114-24 (Muhlhausen i. Thur. Heeht and Dehl (t.m.b II )
Classified List of Second Hand Scientific Instruments. (No. 91 ) Pp

58. (London: C. Baker)

Catalogue of Books relating to the Near East and Egypt including Arabia, the Balkan States Cyprus Mesopotamia, Palestine, the Sudan, etc. (No 502). Pp. 10. (London Francis Edwards, Ltd.).

Sectional Catalogue No 5c. Illustrated Catalogue of Modern Mathematical Brawing Instituments. Pp. 62. Sectional Catalogue No 8b. Illustrated Catalogue of Drawing Scales, Parallel Rules, Participalphs, Endographs, Drawing Boards, T-Squares, Set Squares, etc. Pp. 61-101. (Lindon W. H. Harling.).

Catalogue of Telescopes, etc. Pp. 62. (London W. Ottway end Co., Ltd. Ealing.)

Ltd, Ealing)
A Complete Catalogue of Books Pp. 44 (Cambridge W Heffer and Sons, Ltd., London Simpkin, Marshall and Co., Ltd.)

## Diary of Societies.

#### SATURDAY, NOVEMBER 3

SALUMDITY, NOVEMER 5

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North Wales Distinct Meeting) (at Town Hall, Llandudno), at 10 am -Paper by W T Ward -At 2.50 - Mr Hodgson Ferro-Concrete ROYAL SOCIETY OF MEDICINE (O'Dology Section), at 10.50 am -Dr J S. Flase: A National Investigation of Otosclerosis (Presidential Address) INSTITUTE OF BLITTEL FOUNDINGTON (Lancashire Branche) (northly with West Ruding and Lancashire Branches) (at Huddersheld), at 2.50 - F W Rowe Metallings in teal Manufacture ROYAL INSTITUTION OF GREAT BRITAIN, at 3-E Caminaerts The Main Features of Modern English Literature (1)

Grologist's Association (at University College), at 3 -Annual Conversation

MONDAY, NOVIVLER 7

ROYAL SOCIETY OF EDINBURGH, at 4.30.—W J M Menzies and P R C. Macfarlane Some Further Notes on the Salmon (value salue) of the River Mosse, Eastern Canadi.—L H Easson and R W Armour The Action of 'Active' Nitrogen on Iodine Vapour.—J W Gregor Experiments on the Pollination of Ledina prepar and folium attainum.—Dorothy J. Jackson. Wing Dimorphism in the Genus Sitoiry and its Inheritance in Salona hypothelia, F (Coleopteta, Pam Chicultonide).—B Kaczkowski Contribution to the Study of the European Sheep.—To be read by title.—E T Copson. On Fourth Constants.

BIGHTMEAL SOLUTY (in National Institute for Medical Research.)

Constants

BIOCHTMICAL SOCIETY (in National Institute for Medical Research, Hampstead), at 5—M Stephenson On a Cell-free Dehydrogenase Obtained from Bacteria — G. A. Harison The Cause of Andrews' Diazo Test for Uramia—Prof. A. Hairison The Cause of Andrews' Diazo Test for Uramia—Prof. A. Hairison The Cause of Andrews' Diazo Test for Uramia—Prof. A. Hairison The Cause of Andrews' Health of the Equation of Alcoholic Fermentation—W. V. Thorpe Presence of Histamine in Tissue Extracts—Dr. O. Rosenheim Note on the Flunescence of Engosterol and its Cause—M. G. Eggleton and P. Eggleton. A Few Observations Concerning Phosphagen—Demonstrations—A. Simple Shaker for Light Objects, Prof. J. T. Irving—A. New Colorimeter Based on Lovibond's Colour System, Dr. O. Rosenheim and E. Schustei.

Addless

On AL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting
Society of Engineers (at Geological Society), at 6.—H w Towse and
others Discussion on Economic Transport
Institution of Electrical Engineers (Informal Meeting), at 7—
C H Holbeach and others Discussion on Recent Developments in
Electro-Medical Appliances.
INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales
(Liverpool) Centre) (at Liverpool University), at 7—w McCleiland
The Applications of Electricity in Waiships
Society of Chemical Industry (London Section) (at Chemical Society),
at 8.—Recent Advances in the Hydrogenation of Oils —E R Bolton
General Introduction —Part 1—K A Williams (a) Selective Hydrogenation (b) Melting Point of Hydrogenation of 18.—Part 2—18 G
Pelly Hydrogenation of Fatty Acids and Neutral Oils —Part 3—
E J Lush The Activity of a Nickel Catalyst
ROYAL Institute of British Architects, at 8.30—President's Inaugural
Address
Devices of the Section of Potatory Schools at 8.45—Dr

Address

CAMBRIDGE PHILOSOPHICAL SOCIETY (IN Botany School), at 8 i5 —Dr. Hugh Scott Nariative of a Journey in Central Abyssinia Hungerian Society (at Cutlers' Hall), at 9 —Earl Russell, Dr. J Neal, R Goddard, Sn. Herbert Waterhouse, and others. Discussion on The Lard Polytop of the Dector Legal Peuls of the Doctor

#### TUESDAY, NOVEMBER 8

ROYAL SOCIETY OF MEDICINE (Therapeutics Section), at 5—Dr R D Lawrence Studies of Unusual Diabetics (a) An Insulin Resistant Case; (b) Recovery from (c) Pituitary Diabetes after Pregnancy—Dr. F Parkes Weber A Note on Artificial Cerebral Congestion against

ROYAL INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), Institution of Petroleum Technologists (at Royal Society of Arts), Institution of Petroleum Technologists (at Royal Society of Arts),

At 5 30

ROYAL SANITARY INSTITUTE, at 5 30.—Major H Barnes The Royal Commissions on Health and Housing A Retrospect and Forecast Institute of Marine Engineers, at 6 30—In F Sass A New Type of Solid Injection Double-acting Two stroke Oil Engine ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7—A J Bull The Principles of Photo-Engraving Institution of Electrical Engineers (Scottish Centre) (at Royal Technical College, Glasgow), at 7 30.—W. McClelland. The Applications of Electricity in Warships Quekert Microscopical Club, at 7 30—E Ashby The Laws of Plant Glowth

PHARMACHURICAL SOCIETY OF GREAT BRITAIN, at S.—E. S. Peck The Educative Value of Harrison's Work in Pharmacy (Harrison Memorial Lecture)

ROYAL ANTHROPOLOGICAL INSTITUTE (at Royal Society), at 8 30 —Dr Ales Hidlička: The Huxley Lecture
ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8 30 —Dr R L
Langdon-Down Psychiatry and the Report of the Royal Commission (Presidential Address)

#### WEDNESDAY, NOVEMBER 9

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4 -Lt Col. F E Fremantle

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4 — Lt. Col. F. E. Fremantle The Pirecent Studiation in regard to Housing.

ROYAL SOCHTY OF MEDICINE (Surgery Sub-Section of Proctology), at 5.30,—Sir Charles Gordon-Watson and others. Discussion on The Treatment of Cancer of the Rectum by Radium

NIAWCOMEN SOCILTY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TUNNOLOGY (Annual General Meeting) (in Prince Henry's Room, 17 Fleet Street), at 5.30—T. Rowalt. Railway Brakes — H. O. Clark House Gents. Horse Gears

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6 -S T Dutton The Layout and Manulacture of Railway Points and Crossings.

The Layout and Manulacture of Railway Points and Crossings.
Instruction of Electrical Engineers (South Midland Centre) (at Binmingham University), at 7—F Forrest Economic Aspects of Pulversed Fuel—Prof A W Nach Present and Future Possibilities of Extracting Oil from Coal—Prof K N Moss Coal Analysis in Relation to Heat Value for Steam Raising
Instructs of Metals (Swansea Local Section) (at Thomas' Cafe, Swansea), at 7—Di P MacNail Pyrometers in Works Practice
North-East Coast Instruction of Engineers and Supporting (Graduate Section) (at Newcastle upon-Tyne), at 7-15.—F H Todd Chauman's Addicss
Instruct of Metals (Sheffield Local Section, jointly with other local Societies) (in Sheffield University), at 7-30—Sir William H Bragg Application of X rays to the Study of the Crystalline Structure of Materials.

North-East Coast Institution of Engineers and Shipbuilders

Materials.

North-East Coast Institution of Engineers and Shipbuilders (Middle-brough Graduate Branch) (at Cleveland Scientific and Technical Institute, Middle-brough), at 7:0)—J. Physim. Valves and Valve Gear.

Royal Society of Arrs, at 8—Lieut Col Mervyn O Goman. Road Traffic Problems of the Pedestrian.

Society of Chemical Industrial Contingual Section).—S. R. Trotman and Dr. E. R. Trotman. The Action of Chlotine and Hypochlorous Acid on Wool.

Preprinting of Mechanical Engineers (Shaffield Branch).—Sir William.

INSTITUTION OF MECHANICAL ENGINEERS (Sheffield Branch) —Sir William II Bragg Application of X rays to the Study of the Crystalline Structure of Materials (Thomas Hawsley Lecture)

ROYAL Society, at 430—C D. Ellis and W. A. Wooster The Average Energy of Disintegration of Radium E—E T S Appleyard and H W B Skinner. On the Excitation of Polantsed Light by Blection Linjact 11. Mercury—Tobe read by tatle only:—J I. Bunchnell and T. W. Chaund, Commutatine Ordinany Differential Operators—Prof. L Hill: Measurements of the Biologically Active Ultra-violet Rays of Sunlight—Prof. E C. Baly, J B Daves, M R. Johnson, and H Skinners. The Photosynthesis of Naturally Occurring Compounds. 1—Prof E C G. Baly, W. E. Stephen, and N R Hood The Photosynthesis of Naturally Occurring Compounds. 11—Prof E C G. Baly, W. E. Stephen, and N R Hood The Photosynthesis of Naturally Occurring Compounds. 11—Prof B. C. C. Baly and J. B. Davies. The Photosynthesis of Naturally Occurring Compounds. 11—Prof B. Davies. The Photosynthesis of Naturally Occurring Compounds. 11—Prof B. Davies. The Photosynthesis of Naturally Occurring Compounds. 11—Prof B. Davies. The Photosynthesis of Naturally Occurring Compounds. 11—Prof B. Davies. The Photosynthesis of Naturally Occurring Compounds. 11—Prof B. Davies. The Photosynthesis of Naturally Occurring Compounds. 11—Prof B. Davies. 12—Prof. 12—Prof. 12—Prof. 12—Prof. 12—Prof. 12—Prof. 13—Prof. 13—Prof. 13—Prof. 13—Prof. 13—Prof. 14—Prof. 14

LONDON MATHEMATICAL SOCIETY (Annual General Meeting) (at Astronomical Society), at 5—Dr. II. Cramer. On an Asymptotic Expansion Occurring in the Theory of Probability—Prof. G. H. Hardy. A Theorem Concerning Trigonometrical Series—Tr. Kaluza und G. Szego Uber Reihen unt lauter positiven Gheden.—A. W. King. Notes on the Geometrical Representation of Functions of One and Two Variables—E. H. Linfoot. On the Law of Large Numbers—Prof. W. P. Millie The Stangent Hypequadrics of Noether's Canonical Curve for p=5—Prof. L. J. Mondell. Minkowski's Theorem on the Product of Two Linear Forms—S. Pollard. On the Criteria for the Convergence of a Fourier Series—S. Pollard. and R. C. Young; On the Integral (b) 1995. bdF(1) -T G. Room : Some Configurations based on Five General

Planes in Space of Ten Dimensions—E C Titchmaish On an Inequality Satisfied by the Zeta Function of Riemann—Prof H W Thirbuil The Martrix Squate and Cube Roots of Unity Royal College of Physicians of Lordon, at 5—Di H R Spencer—The History of British Midwirey (1650–1800) (Fitzhetick Lectures) (II) Royal College of Surgeons of England, at 5—Sn Cuthbert Wallace. Enlarged Protate—a Review (Biadshaw Lecture)
Royal Instruction of Great Britan, at 515—II. Chilord Smith—The Furniture and Equipment of the Medicial House (II)
Royal Photographic Society of Great Britan (Informal Meeting of Colour Group), at 7—J Rowatt The Lignose Colour Process
Institution of Effectival Engineers (Dundee Sub Centre) (at University College, Dundee), at 7–30—A S M'White Electrical Repairs to Motors and Dynamos—Institute of Mittis (London Local Section) (at Royal School of Mines), at 7–30—C C Paterson—Some Metallurgical Problems of the Electrical Industry

Industry

Industry

OPHCAL SOCIETY (at Imperial College of Science), at 7:30—J R Hamblin and T H Winser. On the Resolution of Gratings by the Astignatic Eye —O Aves. The Deviograph and That Frame (Enstrument of Merchanical Engine Has (Leeds Branch) — Su William H Bragg. Application of X-rays to the Study of the Crystalline Structure of Materials (Thomas Hawsley Lecture)

INSTITUTION OF MICHANICAL ENGINEERS (South Wales Branch) — C. J. T. Billingham. Charman's Address.

#### FRIDAY. NOVEMBER 11

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30 -M M S Gubbay

Indigenous Indian Banking
ROYAL ASTRONOMICAL SOCIETY, at 5
PHYSICAL SOCIETY (at Imperial College of Science), at 5
INSTITUTION OF MECHANICAL Engineers (Informal Meeting), at 7.—
F. Clements and others. What is wrong with Industrial England 
JUNIOR INSTITUTION OF ENGINEERS, at 7.30—Annual General Meeting

## SATURDAY, NOVEMBER 12

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—E. Cammaerts: The Main Features of Modern English Literature (11). Physiological Society (at Institute of Physiology, Cardiff University).

#### PUBLIC LECTURES.

#### SATURDAY, NOVEMBER 5

Horniman Museum (Forest Hill), at 3 30 -H. Harcourt Indian Pictures and Problems

#### MONDAY, NOVEMBLE 7

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 1.15—1 Pr. C. Singer The History of Medicine: Syphiles, Inflitenza, and Typhond Fever. (Succeeding Lectures on Nov. 14 and 21)
UNIVERSITY COLLEGE, at 5.15—DI E. A. Hauser. The Colloid Chemistry of the Rubber Industry (Gow Lectures). (Succeeding Lectures on Nov. 9, 11, 14, 16, and 18)
GRESHAM COLLEGE, at 6—Sir Robert Armstrong Jones: Physic (Succeeding Lectures on Nov. 8, 10, and 11.)
EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7—Principal J. C. Wallace. The Cultivation of the Potato UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 1.15 - Dr. C

#### TUESDAY, NOVEMBER 8.

ROYAL SCHOOL OF MINES, at 5 15 - Dr. G Shearer A rays and Metals (Armourers and Brasiers' Company's Lectures) (Succeeding Lectures on Nov 15 and 22)
BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Royal Society of Arts),

at 815.—Dr H. Crichton-Miller and K. Richmond, The New Psychology, a Department of Education of Medicine? Chairman, Dr. C. S.

#### WEDNESDAY, NOVEMBER 9.

KING'S COLLEGE, at 5 30 .- Dr C Norwood · Secondary Education (II.):

The Boys Boarding School
University Collings, at 5 30.—If C. Grondahl Regions and PlaceNames in Norway (Succeeding Lectures on Nov 16, 23.)—P B
James. The Decoration of Bookbundings
LONDON SCHOOL OF ECONOMICS, at 6 —Prof. F. R. M. de Paula: Office
Machinery Accounts as an Aid to Management.

#### THURSDAY, NOVEMBER 10

UNIVERSITY COLIEGE, at 530 -Miss E Jeffries Davis More London Place-Names (Succeeding Lectures on Nov 17, 21, Dec 1 and 8.)
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5 t5 -R II. Fowler: Statistical Mechanics Old and New (Succeeding Lectures on Nov. 24

ROYAL SOCIETY OF ARTS, at 8.15 — Major H Barnes The History of Housing Housing before 1885 (Chadwick Lecture)

## SATURDAY, NOVEMBER 12.

HORNIMAN MUSEUM (Forest Hill), at 3.30 -Mrs R. Aithen: Dances of the Pueblo Indian



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## Technical Education and Industry.

EPEATEDLY in these columns we have urged a revision of traditional philosophies of education We have shown that, as a result of the transition from a non-scientific to a scientific basis of civilisation, vast powers have been placed in man's hands—powers by which life can be freed from unnecessary toil, and denuded of the harmful mysticisms, superstitions, and pruderies which cramp its social, political, and ethical qualities. Far from making recommendations which would tend to a system of education built merely upon an arid, mechanical efficiency, we have insisted that a knowledge of the truth of the natural world as shown through physics, chemistry, astronomy, and like subjects, and a knowledge of the truth of man's place and relationships in the scale of life as shown through subjects such as biology, is not incompatible with, but the sound basis of, an appreciation of beauty whether enshrined in literature, art, or an ordered state which understands race experience sufficiently to be able consciously to control its future experience

So much for what might be called fundamentals They may be regarded by an instinctively (and, in some respects, rightly) conservative academia as involving changes too sweeping to be practised until the present machinery of civilisation can absorb them. We agree that there may be something in the objection. We realise that the vast body of new knowledge which science has produced during the last twenty years or so and thrust into practical use in social, industrial, and commercial fields has not yet been grasped by legislators, teachers, and business men We cannot avoid noticing, for example, the unconscious legal cruelty which may arise from failure to discern the dividing lines between the scopes of law, medicine, and sociology. Nor can we fail to observe how great issues which will shape the future are constantly fogged or misdirected by ignorance. The vast forces of science have not yet been co-ordinated and absorbed by the dominating operators of our social mechanism so that the community may reap the benefit But although it is clear that, in spite of a recent suggestion, it is impossible to call a temporary halt in the world of science, we can sympathise with the view that its discoveries and implications must be more widely understood if order is to be brought out of the present chaos.

Obviously, the production of that order will be a slow progress: obviously, it must depend upon a system of education carefully planned with the view of a better social order. These are facts which must be faced steadily. But a carefully planned system of education will not, in itself, solve our difficulties. The welfare of Great Britain and its institutions rests ultimately on the success of its industry. That is another incontrovertible fact. Teachers have been reminded of it frequently, but it must be faced equally by those responsible for the successful development of industry itself.

For the benefit of the mind careful to the point of fearfulness, we would point out that, in urging a revision of educational notions, we have not presented suggestions which have been unduly hurried Those suggestions have found reflection in the reports of bodies appointed to examine important aspects of our present discontents. We have, for example, commented in previous issues upon the findings of the Hadow, Malcolm, and Balfour In all these reports the need for Committees. strengthening the link between education and industry has been emphasised. That emphasis has not come only from official committees. all sides enlightened teachers and leaders of industry have been seeking to join forces. The Emmott Committee of Inquiry into Technical Education and Industry has been, perhaps, the venue of the most varied representatives desiring to commence the solution of this particular problem; and at the recent meeting of the British Association, education and industry was a subject to which a complete session was devoted. Papers read by educationists and industrialists showed clearly that their interdependence is realised by both sides. Especially was it made clear that educational machinery, capable of great development, already exists to supply the requirements of industry, even though no national administrative machinery, through which both sides can adequately express their needs, has yet been formu-Clearly, however, the rapprochement of education and industry has commenced.

The papers to which we have referred were well selected. From the educationist's point of view, arguments were presented for the grouping of social, industrial, and educational problems; the work, general difficulties, and possibilities of a typical technical institution were outlined; the results and advantages obtained by a college which trains engineers on a definite production basis rather than an 'exercise' basis were described. From the industrialist's point of view, criticism of present elementary and secondary school curricula was advanced and a plea was made for a revision

which might give capable managers and workers to industry no less than balanced and thoughtful citizens to society, suggestions were made as to industry's contribution of forms of essential education not always included in the forms' processes of the school. Altogether, we gained a very satisfactory impression that ancient antagonisms are disappearing, and that, since the industrialist has now realised the value-commercial as well as social-of education to his industry, and since the teacher—at least on the technological side—is prepared to shape his work in the wide interests of industry, it appeared to be but a matter of time until the resulting benefits will be enjoyed by student, worker, teacher, and employer.

We must pause here, however, and examine present facts, and not be swept away from them by pleasant speeches and urbane agreements. Industry has commenced to demand men and women soundly educated and expertly trained for its tasks. The educationist has answered by producing from his universities and technical institutions the type of student the industrialist tells him, and which he believes, is required. But if industry has correctly expressed its needs, and education can fulfil those needs, there ought not to be the slightest difficulty in placing every properly qualified student. That is surely an 'acid test' of the relationship between school and employment.

What, however, are the present facts? In chemical industry, for example, we have been told that there is an almost unlimited field for the technically trained man or woman. But those of us who have some knowledge of the number of graduates in chemistry leaving universities and technical institutions also know the difficulties they often have in securing satisfactory employment. How many graduates in engineering, too, have been able to secure positions in which their training can be adequately used? On the commercial side we recall the demand made by employers for highly trained and broad-visioned employees which resulted in the institution of the Bachelor of Commerce degree; but we have not lacked evidence that possessors of that qualification have not found it easy to secure posts in competition with applicants of no other training than that of commercial experience since the age of fourteen years. It is not to be doubted, we think, that there are well-qualified men and women unable to find openings in industry and commerce, and although we realise that the problem of employment has many aspects, we feel bound to ask

whether employers are prepared *now* to take advantage of education's newest product.

It would clearly be a doubtful move to extend the facilities for special training if the present utput cannot be absorbed Are there, then, sufficient openings at present to justify the extension of facilities for which employers ask? Do the majority of employers sufficiently realise the advantage of securing the well-trained recruit? The employer who has done so seems to be the established and, perhaps, leading industrialist who presents what is assumed to be a complete industrial view before public meetings and official and other committee But what of the employers of whom we hear but little and who have not yet understood the sound benefits which can be secured from trained workers? If it be answered that all employers understand those benefits, then the difficulty of securing employment must be traced to a weakness lying elsewhere For, clearly, while the present position continues we cannot avoid the conclusion that the weakness lies either in education or in industry If it be in education, the employer should indicate it with all speed: if it be in the organisation and methods of industry, they must either be altered or else clear instructions, based upon them, must be submitted for the consideration of educationists.

There is certainly one point arising out of the organisation of mdustry which was touched upon during the British Association discussion by an educational and by an industrial representative. The former referred to the growing impression that promotion to the higher posts in engineering proceeded more readily from the office than from the works, and that this industry is already losing heavily by bribing its best boys into the administrative rather than the production side. The latter underlined the same complaint. No amount of inducement, he said, seemed able to overcome what appears to have become a distinct difference in status. This fault of shaping the bright boy to the black suit was regarded as belonging to parents and teachers rather than to employers. But are parents and teachers to receive all the blame? Is it not generally true that difference of status exists? Is it not generally true that in times of bad trade it is the production side which suffers while the administrative side enjoys something very like permanence? Can the employer help to avoid this—a very real threat to the future skill and welfare of industry?

We hope we shall not be misunderstood We have sketched the need for an educational system

which shall fit modern civilisation particularly through its effect of wiping away the ignorance which may fog and warp the issues which are shaping the future We have insisted that the linkmg of education and industry is an essential part of that new system. We have welcomed the evidence which shows that its necessity is being more and more realised; and if we have paused to examine present difficulties which tend towards the nullification of the promise that evidence holds out, we have not done so merely to apportion blame or praise to any particular quarter. It is simply that, in our earnest desire that these new and beneficial movements shall proceed unhampered, we have attempted to indicate some barriers which need speedy removal.

## Science and Theology.

- (1) Concerning Man's Origin · being the Presidential Address given at the Meeting of the British Association held in Leeds on Aug. 31, 1927, and recent Essays on Darwinian Subjects. By Sir Arthur Keth (The Forum Series) Pp. ix +54 (London · Watts and Co, 1927.) 1s. net
- (2) Religion without Revelation. By J. S. Huxley.
   (What I Believe Series) Pp. 392. (London: Ernest Benn, Ltd., 1927.) 8s. 6d net.
- (3) The Church and Science: a Study of the Interrelation of Theological and Scientific Thought. By Dr. Hector Macpherson. (The Living Church Series) Pp. 254 (London James Clarke and Co., Ltd., 1927) 6s net.
- (1) SIR ARTHUR KEITH, in a foreword to his presidential address to the British Association, just published by Messrs. Watts and Co., makes a notable observation. He writes that although the outburst in the public press which followed his defence of Darwinism indicated "that Daytonism is very much alive throughout the land, and that the only science people are prepared to accept is that enshrined in the book of Genesis," yet, that he was encouraged by the reception given to his address by the leaders of religious thought. The words in which he places this upon record are sufficiently important to quote in full:
- "Far from being in opposition, they want to know all that can be known of the universe in which we live, and of that remarkable aberrant product of Nature which we call Man. They have grown up m the post-Darwinian period, and no longer regard the great army of science as an enemy, but as a friendly power. They realise that religion cannot stand still, that it too must evolve, and that it is the duty of theologians not to expect scientific men

to modify their facts to fit religious views, but that religion must be modified to fit man's changing needs, and to be mkeeping with the truth as revealed by scientific inquiry. It may take long before we reach perfect accord, but nothing but good can come out of a working agreement effected between men who are striving for the betterment of humanity through an increase of well-ascertained knowledge. Religious leaders and men of science have the same ideals, they want to understand and explain the universe of which they are part, they both earnestly desire to solve, if a solution is ever possible, that great riddle Why are we here?"

Sir Arthur Keith is undoubtedly justified in believing that religious leaders, so far as the natural sciences are concerned, are by no means reluctant to accept new ideas. If this is gratifying to men of science, it is equally encouraging to theologians to observe among men of science an increasing tendency to take religion seriously and to attach importance to the religious view of life. Nor is this the case only, as might perhaps have been expected, among anthropologists and psychologists, to whose subject matter religion belongs, it is no less conspicuous among physicists and biologists

(2) Among biologists, the latest example of one taking an interest in the religious problem is Prof. J. S. Huxley, who has published his views in a volume entitled "Religion without Revelation" The book is inspired by the belief that

"One of the most urgent needs of humanity at the present time is a common outlook, comparable in its comprehensiveness and wide acceptance with the common outlook, religious and philosophical, which dominated the Middle Ages."

Prof. Huxley does not fail to indicate what he believes should be the foundations of a reformed theology; these will be threefold, and will consist " of agnosticism, of evolutionary natural science, and of psychology." We may presume that the word agnosticism is used in a wide and general sense to describe an attitude which is mistrustful of all dogmatic systems, positive or negative, which are prisons of the mind. With regard to evolutionary science, Sir Arthur Keith's address makes it clear that Darwin's theory of man's origin is not only unshaken but unshakeable; and we may take it that the evolutionary outlook has come to stay. As for psychology, it is clear that a systematic study of the facts of religious experience is a necessary basis of any sound theology.

Our comment may suitably take the form of examining each section of the triple basis in turn. With regard to agnosticism, we are inclined to wish that Prof. Huxley had avoided the word. It conveys the impression that those who use it doubt

whether any large measure of trustworthy truth is available where ultimate questions are concerned. If the historically untenable idea of a supernaturally revealed dogmatic system is to be replaced, some new theory of the attainment of religious knowledge will have to be provided. We fear that Prof. Huxley does not clearly envisage the nature of the problem with which those who believe in religion without believing in 'revelation' are faced That problem is the provision of an altogether new theory of revelation.

With regard to evolution, the introduction of this conception into our thinking is in reality the only sure safeguard against dogmatism, and makes anything like systematic agnosticism unnecessary. Evolutionary ways of thinking have imported some measure of relativism into our ideas without endangering the indispensable notion of objective truth. They have banished dogmatism without introducing scepticism As Prof Huxley puts it

"Thought evolves equally with life. Religious systems which were inevitable products of humanity's childhood or of his adolescent thinking . . . are not for that reason final. Ideas which in their time and season meant immense advance . . . may actually become harmful when circumstances alter and the old ideas are found to be hindering the progress of new and better ideas."

Then, with regard to psychology, the last part of the threefold basis. We owe a great debt of gratitude to Prof. Huxley for having included an autobiographical chapter in his book. It is to be feared that some men of science have written of religion while having very little first-hand experience to guide their speculations. This is not the case with Prof. Huxley, who seems to have been through religious experiences which only differ from the normal by being more intense His experience seems to have taken the form of nature-mysticism united with fervent moral idealism, but apparently unconnected with the dogmas of 'revealed' religion, from the teaching of which his childhood had been free. (It is to be noted, however, that he was brought up in an atmosphere of vigorous moral earnestness, quite different in character from much of the frivolous irreligion of the present day)

In view of all this, it is a little of a disappointment to find Prof. Huxley inclined to surrender his experience to the inadequate and rather shallow interpretations of the psychologist, who, to be sure, is too much with us to-day He writes:

"They [the religious experiences] and my reading also convinced me that the revelation of the mystic vision is revelation only in a psychological sense, not literally. There need be no supernatural

being or force making the revelation; nor is the revelation one of an external reality."

This last sentence, however, seems to be quite unhelpful dogmatism. It would have been more profitable, and more scientific, to inquire what kind of truth mystical insight may be expected to supply us with, whether similar in kind to that supplied by æsthetic or moral insight, or otherwise. In point of fact, some philosophers, quite innocent of theological bias and without the qualification of having enjoyed Prof. Huxley's remarkable religious experience, are inclined to attribute considerable significance to such phenomena. Mr C D. Broad, for example, though confessedly almost devoid himself of such experiences, has expressed his belief "that they are probably of extreme importance in any theoretical interpretation of the world"

It is a curious fact that about the real bone of contention between religion and science at the present time, that is, miracle, Prof. Huxley says scarcely anything. This is at present the crux. It is as it were a correlative to revelation, as this is the supernatural in the sphere of knowledge, so the miracle is the supernatural in the sphere of action. In what sense, if any, we can hold to either of these conceptions needs thinking out very carefully

(3) Dr Hector Macpherson, in his book "The Church and Science," does devote a chapter to the miraculous. He points out that the reformers took over Aquinas's conception of miracle, which at least had the advantage of being clear and definite, it was an event having its cause outside Nature. The difficulty, of course, is that until you know the whole of Nature, you cannot tell what lies outside No man of science will consent to adopt this method of explanation, as it stultifies his methods entirely. Dr. Macpherson quotes extensively from Mr J. M. Thompson's "Miracles in the New Testament," a book which made a considerable stir when it appeared in 1911 Thompson's view was that the doctrine of the Incarnation can stand quite independently of miracles; but as he was inhibited by the Bishop of Winchester at the time, it does not look as if his views were accepted by the ecclesiastical authorities As a matter of fact, the book was a careful piece of textual and literary criticism of the New Testament documents concerned, and its reception showed that orthodox theology had not yet come to terms with the critical study of literary sources other words, the religion and science conflict has settled down at present to a controversy between scientific history and theological history.

J. C. HARDWICK.

# Cultures and Migration.

Psychology and Ethnology. By Dr. W. H. R. Rivers. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xxviii + 324. (London Kegan Paul and Co., Ltd., New York · Harcourt, Brace and Co., Inc., 1926) 15s. net.

THIS volume is one of a series entitled "The International Library of Psychology, Philosophy, and Scientific Method." Rivers was above all a master of method, and had he lived to write a book on method in the historical investigation of human cultures, he would have added to the already great debt anthropologists owe him. The present work is a collection of lectures and essays, dealing mainly with the constant theme of the historical school of anthropology, the unity of culture. The greater number were delivered to somewhat mixed audiences, hence there comes about an almost wearisome reiteration of the hypotheses, and perhaps—apart from pan-Egyptianism —some over-emphasis of the differences between the views put forth by the historical or diffusionist school and by other anthropologists. The chapters have not been arranged chronologically to show Rivers's contribution to method—indeed, his first and by far his most important contribution, "A Genealogical Method of Collecting Social and Vital Statistics" (Jour. Roy. Anthrop. Inst., vol 30, 1900), has been omitted—but come under a few selected headings.

The reader who bears with these disadvantages will be rewarded, not with the proof or disproof of the theories of the extreme diffusionists, but by the discovery of some of the principles and results that Rivers worked out when studying the contacts of peoples in Melanesia, where he carried out the plan he had previously elaborated for obtaining exact information; that is to say, he used the genealogical method with the study of kinship as the basis of investigation. When he examined his material he came to certain conclusions which may be looked upon as his chief methodological results, in this review arranged and to a limited extent discussed under numerical headings:

(1) That social structure, the framework of society, is fundamentally important, and not easily changed except as the result of the *intimate blendings of peoples* or of the most profound political changes, and for that reason furnishes the firmest foundation on which to base the process of analysis of *culture*. The relative permanence of

the social structure is so great that its course of development may furnish a guide to the action in order of time of the different elements into which it is possible to analyse a given culture complex (pp. 135-8). These two sentences are condensed from "The Ethnological Analysis of Culture," but the italics are my own.

Yet, if I understand aright the general trend of these essays, Rivers later accepted a more extreme diffusionist view, namely, that cultural changes were introduced by the carrying about the world by small bands of foreigners of definite elements, independently of any general cultural blending. On the other hand, a collection of essays offers no such continuous structure that it is possible to be certain that Rivers had entirely realised the full significance of the acceptance of this proposition, which logically would lead to the rejection of so much of his previous work. Such wholesale modification of viewpoint seems scarcely likely, for Prof. Elliot Smith himself has said in the preface to "Social Organisation," published in 1924. "On his own admission his work on social organisation was his greatest achievement in his chosen field of investigation," so we may perhaps regard "blending" as not consciously jettisoned, though in many instances Rivers no doubt did accept the free transmission of foreign elements. As an example of the kind of difficulty referred to, it is sufficient to compare the views on the dual organisation put forward by Rivers on one hand and by Prof. Elliot Smith and Mr. Perry on the other, who regard the dual organisation of society as one of the elements of culture that arose in Egypt and was carried about the world (Elliot Smith, "Encyclopædia Britannica," vol. 30, article "Anthropology"; Perry, Appendix 3 to Rivers's "Social Organisation"). These views may be contrasted with the treatment of dual organisation in the "History of Melanesian Society," for example, vol. 2, p. 250.

(2) The second principle is that involved in the disappearance of useful arts; this is a feature of the degeneration of culture which plays so large a part in the scheme, and is one which had long called for examination. Here we may direct attention to one aspect of the controversy which might be overlooked by those who are only interested in the proof or rejection of the general idea, namely, that it is the 'common sense' view that man is guided by reason which is here refuted. In the examination of the causes of the disappearance of the canoe from the Torres Islands and Mangareva, Rivers was led to reject material and

social factors as insufficient in themselves, and he saw in the loss of the magical and religious rites accompanying the craft the loss of the craft itself. He does not, however, suggest any reason for the loss of the magic.

"Quite as striking as the loss of useful arts is the extraordinary persistence of elements of culture which seem to us wholly useless . . . this . . combines . . . to make us beware of judging human culture by purely utilitarian standards" (p. 208). One of the difficulties here is to recognise what to the savage is a purely utilitarian standard

(3) The extent of the influence of one people upon another depends upon the difference in the level of their cultures. A very small number of immigrants of a sufficiently high culture can have a relatively enormous influence on a low culture. This is the principle relied upon for the spread of the megalithic culture in the essay entitled "Contact of Peoples," and comparison is made of European influence on peoples of the lower cultures on one hand and on those of India and China on the other.

(4) The motive for migrations determines their distribution, which might otherwise appear fortuitous Rivers accepted Mr. Perry's theory, that the motive was the search for wealth or life-giving substances · "The force was attractive rather than propulsive, viz. the love of wealth, which is still the most potent factor in immigration" (p. 171) This was probably not intended as a principle to be taken without other subsidiary factors, for though the love of wealth may always be present, immigration is periodic. Moreover, when particular instances are examined the thesis is likely to break down, as in the example afforded by the recent discussion on pearls in Man; again, it is doubtful whether the love of wealth had any considerableinfluence on the first great spread of Islam, though trading and slave raiding undoubtedly assisted or even led to later movements.

(5) Ancient beliefs tend to be preserved with greatest fidelity not near their old home but in remote spots, among people of a simple mentality. This conclusion was drawn after the construction of a hypothetical scheme to account for belief in 'soul-substance' in Melanesia (including New Guinea), as well as for the burial customs of San Cristoval in the Solomon Islands. The reason adduced is the simple mentality of the people, which leads them to "accept without any great modification beliefs which take their fancy, while the absence or scarcity of later external influence

prevents the modification, or even obliteration of beliefs, which are always liable to occur among more sophisticated peoples and in regions more open to the play of external influence" (p. 118). This principle, the parallel to that of the distribution of living animal forms from a geological centre, seems to have been elaborated independently. With all necessary reserve, the reviewer would place on record his belief that of late anthropologists have tended to underestimate the fluidity of native custom and its capacity, nay its tendency, to modification within its own sphere of activity without foreign stimulus.

(6) "Wherever we find diversity of funeral rites, we may safely conclude that there has been diversity of culture" (p. 163). This conclusion is drawn from the general observation that rites, ideas, and beliefs concerning the dead are among the most sacred of human reactions, and held with the greatest conservatism. The diversity of funeral rites in Australia is one of the main causes that led Rivers to suspect the complexity of Australian culture.

Handled with caution, all of the above are useful principles, but the need for caution cannot be overrated. For though the diffusionist school that Rivers upholds in this volume is sometimes called the historical school, its relation to history is precarious and depends on a number of bold The existence of the Egyptian assumptions. culture is an historic fact, its connexion with the megalithic culture a courageous deduction with which archæologists in general disagree. Moreover, the migrations from Egypt with which the diffusionists deal are all ignored by historic records, nor has a single specimen, not even a potsherd, of Egyptian or Near Eastern manufacture been found in those localities supposed to have been most subject to Egyptian influence. The assumed motives of the migrations are yet bolder. Present customs are explained in the light of hypothetical migrations, and the megalithic culture itself explained by comparison with modern custom. The danger of the vicious circle is obvious, yet this statement should not be taken to imply that we need be satisfied with the methods of anthropology before the florescence of the diffusionists No doubt there is much to be learnt by the careful application of Rivers's principles to some known historic movement, as, for example, the spread of Islam. The different phases in its extension could be studied; its conquests and its forms of peaceful penetration contrasted, and the varying results examined. Such an examination

might even justify some of the more far-reaching speculations of the school. Above all, such studies, starting from definite historical facts, and continually checked by these, should throw light on the formation of new culture complexes, and thus to some degree act as a test of the validity of the hypothetical schemes put forward by the diffusionist school.

C. G. Seligman.

# Two Fundamental Problems in Physical Chemistry.

Physico-Chemical Metamorphosis and some Problems in Piezochemistry By Ernst Cohen. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University.) Pp. vi + 190. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926) 2.50 dollars.

PROF. ERNST COHEN of Utrecht went to Cornell University early in 1926 as the first holder of a non-resident lectureship in chemistry, supported by an endowment given for this purpose by Mr. G. F Baker. His introductory lecture, under the title "Qua vadimus?" has already been circulated to many workers who receive reprints from the van't Hoff Laboratory at Utrecht; but it now appears as the precursor of ten lectures on "Physico-Chemical Metamorphosis" and eleven lectures on "Some Problems in Piezochemistry."

The first series of lectures deals with the transformations (and especially with the suspended transformations) of tin, antimony, cadmium, thallous picrate, cadmium rodide, and ammonium nitrate In all these cases the author provides evidence of the difficulty of securing the complete transformation of a polymorphic solid into one of its possible forms, and the risk that, if sufficient precautions are not taken, the physical data recorded will be those of a mixture of the various forms. This risk must be admitted, but not to the extent of producing a pessimistic outlook, since inconstant results generally provide an efficient danger-signal when a condition of complete equilibrium is not being attained in any given series of experiments. The cases cited, which include those of 'tin pest' and 'explosive antimony,' are, however, of a very interesting character, and include some of the most dramatic results of the author's own researches.

The second series of lectures is chiefly remarkable for the skilful handling which it discloses of the difficult problems encountered in carrying out the common operations of physical chemistry under a pressure of 1500 atmospheres. Under these

conditions, determinations of reaction-velocity, solubility, electromotive force, electrochemical equivalent, velocity of diffusion and viscosity, all call for the invention of appropriate apparatus, embodied in workmanlike designs, for making measurements of a high order of accuracy, whilst paying due regard to the possible effects of contamination by the fluid through which the pressure is transmitted to the system under investigation. It is therefore not an adverse criticism to say that more interest and instruction is to be found in reading how the experiments were made, than in nothing the character of the numerical results that were recorded. It is, indeed, almost a disappointment to read of the unfailing regularity with which the predictions of thermodynamics were fulfilled, since a few violent exceptions would have added an element of sport to what is now an almost monotonous record of difficulties surmounted and goals attained.

Those who know Prof. Cohen's linguistic and literary skill, and in particular his perfect mastery of English, together with the winsomeness of his appeal to his hearers, can paint a vivid picture of the attractiveness of the course of lectures to those who had the privilege of listening to them. The printed record will, however, be read with pleasure by a much wider circle of interested students and teachers, since it provides in a convenient and attractive form the equivalent of two monographs on subjects of wide general interest. T. M. L.

#### Our Bookshelf.

The Making of a Chemical: a Guide to Works Practice. By E. I. Lewis and Geo. King. Pp. 288. (London: Ernest Benn, Ltd., 1927.) 12s. 6d. net.

It must be something like twenty years since Mr. E. I. Lewis achieved fame as the author of an inorganic chemistry, which differed widely in character from most of the text-books that had been written previously. Mr. Lewis's book was specially designed for the needs of boys coming over from the classical side, who did not need to acquire a professional knowledge of the subject, but were expected to secure some measure of scientific culture from its study. His book proved, however, to be of wider value, in that its broad and philosophic treatment made it a suitable revision book for many students who had taken an elementary course, but without acquiring the fuller knowledge of the foundations of his faith, which one looks for in a university worker.

The schoolmaster has now become an industrialist, but without losing either his literary skill or his desire to teach the rising generation. He has, therefore, in collaboration with a colleague, written a book on "The Making of a Chemical,"

m which he gives much excellent advice to the student who is about to enter, and hopes to find a career in, chemical industry. His advice is so good that, if it were all put into practice, the product would be almost too perfect to be useful; it has certainly had the effect of leaving the reviewer with a sense of his own unworthiness to undertake so high and holy a vocation, and to marvel at the lofty heights to which the authors of such a book must themselves have attained.

On the other hand, if the reader is prepared to leave good advice to suffer its usual fate, he will find that the book contains a very useful sketch of the fundamental problems of chemical preparation when carried out on a large industrial scale, and a very readable summary of the typical solutions of these problems. Even more useful, perhaps, is the frequent reference to technical books, since the academic student, who knows how to track down original references with the help of Beilstein and the British Abstracts, may very easily be floored by the problem of finding out where to go for a trustworthy review of the best current practice in some branch of chemical engineering. The authors, one may suppose, have themselves tested and vindicated the usefulness of the books which they cite, and they will have rendered a real service to the young industrial chemist if they are able to guide him in the early stages of building up a technical library of his own.

Sex and Repression in Savage Society. By Bronislaw Malinowski. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xv+285. (London: Kegan Paul and Co., Ltd; New York: Harcourt, Brace and Co., Inc, 1927.) 10s. 6d. net

In this volume Prof. Malinowski restates his position in relation to the Freudian doctrine of the Œdipus complex, showing how that theory of father-and-son antagonism and a mother-and-son attraction based upon a sexual impulse, having been formulated in relation to a patrilineal society, breaks down when applied to the behaviour of peoples organised on matrilineal lines. He then passes on to the consideration of the nature of the influence of the family complex on the formation of myth, legend, and fairy tale, on customs, form of social organisation, and achievements of material culture, and finally passes to what is the most important contribution of his book to this subject, the consideration of the origins of culture, where he finds himself on the borderland between the animal and the human.

On the view that the instincts are plastic, and can be and are moulded by cultural influence, what the Freudians regard as fundamental, the manifestation of the sex instinct and its repression, become incidental. When it appears it is a maladjustment. Prof. Malinowski's conclusion, therefore, is that the building up of the sentiments and the maladjustments which this may entail depend largely upon the sociological mechanism working in a given society. The main aspects of this mechanism are the regulation of infantile

sexuality, the incest taboos, exogamy, the apportionment of authority, and the type of household organisation. This contribution by Prof. Malmowski to the discussion of Freudian doctrines is one of considerable importance, based as it is upon material actually gathered in the field, but it will be a matter for regret if its polemical character in part obscures the fact that it is one of the author's most original and suggestive contributions to anthropological theory

Beitrage zur Kenntnis der Verbanderung und einiger verwandter teratologischer Erscheinungen. Von Dr. Const. C Georgescu. (Botanische Abhandlungen, herausgegeben von Prof. K. Goebel, Heft 11) Pp. 120 (Jena Gustav Fischer, 1927) 6 gold marks

This little work on fasciation contains some experimental and observational results and an incomplete bibliography of the subject. The author points out that fasciation may occur as a modification caused by excess nutrition, attacks of insects, etc., but that it is more commonly a mutation. Celosia cristata, the cockscomb of gardens, is an example of such a species. Its origin is unknown, although it is now cultivated all over the world, but it was known to Pliny. In culture solutions lacking particular salts, no effect was produced, except that the absence of calcium prevented flowering Races of Celosia differed in the degree or amount of fasciation, and bad conditions reduced the number which showed it Experiments were also made with Sambucus nigra.

Fasciation may occur in stems, roots, flowers, fruits, or even stigmas. The author classifies fasciations as dorsiventral or bilateral, which can be anatomically distinguished. Two types of shoots are also distinguished, in one of which there is flattening throughout, while in the other only the tips of the branches are flattened. Fasciation results in abnormal phyllotaxy, and a morphological study is made of this condition, especially in Sambucus and Celosia R. R. G.

Balancing the Farm Output: a Statement of the Present Deplorable Conditions of Farming; its Causes and Suggested Remedies. By Dr. W. J Spillman. (Farm and Garden Library.) Pp.126 + 10 plates. (New York: The Orange Judd Publishing Co., Inc.; London: Kegan Paul and Co, Ltd., 1927.) 1.25 dollars.

The title of this little book indicates that Britain is not the only country in which farming is in a deplorable condition. The cause is the same; current prices run below costs of production. Many remedies have been suggested, and it is surprising to learn that so many countries have adopted various schemes of what our author terms 'valorisation,' that is, an artificial raising of home prices by State action. In regard to all these schemes the author prophesies disaster. In their place he would substitute a scheme of which it is sufficient to say here that it predicates a degree of State interference with private business which—if endurable in an autocratically governed country

like the U.S.A —would not be tolerated in Great Britain. The book, however, is valuable as a reasoned summary of schemes for remedying an undoubtedly serious state of affairs. For ourselves, we would rather pin our faith on the march of knowledge. if practice is outworn, our only hope is science and, again, more science.

Geologisches Praktikum Von Prof. Dr. Rudolf Sokol. (Sammlung naturwissenschaftliche Praktika, Band 13) Pp. viii +248. (Berlin: Gebruder Borntraeger, 1927.) 14 50 gold marks.

Prof. Sokol completed this book in December of last year, but unfortunately he did not live to see its publication; two months later he passed away. The obstuary notice which has been added to his book pays high tribute to his great reputation as a teacher, and the book itself calls for equal praise. After insisting that a geological training demands a preliminary acquaintance with many other branches of scientific knowledge, the subject of map-reading, topographical and geological, is introduced. Instruments are next passed in review, and this section includes an account of the use of the Eotvos balance. Materials are treated at some length; their collection, preparation, and investigation, their nature and distribution and relative ages. Structural geology occupies a third of the book, and the section dealing with faults, their measurement and description, is particularly valuable. Suggestions are given for making and noting observations in the field; for making maps; and for writing up reports. The concluding sections deal briefly with materials of economic importance. A short bibliography is appended, but this is unsatisfactory, since it contains no references to British works. The book is strongly bound and effectively illustrated

The Physiography of the Region of Chicago. By F. M. Fryxell. Prepared by the University of Chicago Local Community Research Committee, and the Chicago Commonwealth Club, for the Committee on General Surveys of the Chicago Regional Planning Association. Pp viii +55. (Chicago, Ill.. University of Chicago Press, London: Cambridge University Press, 1927.) 12s 6d. net.

This very careful study of the physical geography of the Chicago region is a model of the kind of foundation that is desirable for regional survey work, and as such it is likely to be of special value to the many British workers and teachers who are similarly interested in their own neighbourhoods. It is also of more general interest in containing many excellent diagrams and a series of folded maps showing relief, drainage, glaciation, and soils The topics discussed include the great industrial area of the lake plain; the surrounding recreational areas; the pass to the Mississippi valley, the continental divide; the shore line of Lake Michigan; the buried landscape of the bedrock; the agricultural areas and soils; and the geological resources. A large base map specially prepared under the direction of Prof. J. P. Goode folds into a pocket on the back cover.

## Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can be undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of Naturne. No notice is taken of anonymous communications.]

#### The Mathematics of Intelligence.

It has been said by Kant that a science is genuinely scientific in so far as it involves mathematics; and interesting light is thrown on this dictum by considering it in reference to the various attempts that have been made to introduce mathematics into psychology. First came the grandiose effort of the Herbartian to depict mathematically the interaction of ideas. This tailed for total lack of experimental support. Then followed the great and very successful attempt of Weber and Fechner to measure sensory discrimination. Much more recently, there has been an invocation of mathematics for the purpose of analysing mental ability. As this last attempt is now very much perturbing psychologists all over the world, let us consider it in a little more detail.

In the year 1904, on the basis of a mathematical theorem coupled with some actual observation, the doctrine was advanced that the measure of any individual in any ability could be divided into two factors; the one was common to all the abilities concerned; whereas the other was specific to the one ability alone. These two factors were designated by the letters g and s; and the extremely important corollary was drawn that, by averaging together many dissimilar mental performances, the influence of the s's would tend to cancel out, leaving an approximate

measure of the pure g.

This doctrine was very unexpected, and gave rise to an acute controversy which has continued ever since. On the mathematical side, the objections raised have one by one been either refuted as pointless, or else met by further developments. On the side of observation, the scope has been continually broadened. Originally, the work had been limited to a single experimenter dealing with little more than 100 individuals, all of whom were young boys. But already in 1912 the range had been extended to 14 experimenters treating 1463 boys and girls, men and women, sane and insane. At the present day, this number of experimenters has certainly been quadrupled, whilst the number of individuals has grown to many scores of thousands. Finally, the attempt was made by me in a book entitled Abilities of Man" (Macmillan, 1927) to bring all this work into one systematic whole. The interpretation of g found to account best for all the observed facts was to conceive it as measuring some general 'energy responsible for all the activities of the mind. s's, on the other hand, were taken to be the various 'engmes' into any of which the energy could alternatively be directed.

In addition to the g which thus measured the quantity of the mental energy, there was also determined a value p which measured the degree of the 'inertia' of this energy; and furthermore, an o which measured the degree that the supply of the energy tended to oscillate. These three measures conjointly were said to furnish the cardinal features distinguishing the abilities of one individual from those of another. The evolution of the doctrine went further still, carrying it far beyond the whole sphere of psychology known as that of individual differences. For during the time that the facts belonging to this

sphere were being investigated, those appertaining to 'general psychology' were being treated from a fundamentally novel viewpoint (that of the doctrine known as 'noegenesis'). The surprising result was that these two spheres, hitherto kept by psychology in disastrous divorce from one another, now litted as hand and glove Finally, both these spheres of cognition, that of individual differences and that of general psychology, have in the continued development of the doctrine of g and s become organically united with that other great domain of the mind which is not cognitive but conative; it does not deal with knowing, but with striving and deciding. To the gand the s's of the energy and the engines, there has now been added a w, which brings all these into action, playing thus the part of the 'engineer.' Accordingly, the entire movement having as its core the concept of g has constituted a great endeavour to supply psychology at last with a unified, complete, and genuinely scientific foundation

A review of "The Abilities of Man" was published in Nature of Aug. 6, the reviewer adopting an extreme attitude in the now rapidly dwindling opposition party. For my part, I welcome this review in so far as it expresses the chief lines that may still be taken up against the book. But I cannot help regretting that it should present an entirely incorrect picture of what is given in the book itself. In the first place, there is the grave default that the foregoing immense scope of the work done—just the scope that the book expressly set out to narrate—is not even hinted to the reader of the review; and then this, on the positive side, is throughout strangely permeated with vital misapprehensions, as will be seen by taking each of its

points in turn.

1. The beginning of it is a general complaint that the statements in the book cannot be adequately verified for lack of sufficient arithmetical data and mathematical demonstrations. But it must be replied that data are really furnished in very great quantity, so that any one can check the arithmetic as much as he pleases; while all the chief mathematical demonstrations are given fully in the appendix.

2 Next, the objection is raised that the book criticises the definitions of 'intelligence' given by other people, but fails to supply one itself. Really, the tenor of the book was to suspend usage of the highly equivocal word 'intelligence' and to show unequivocally what mental powers actually exist. Then, indications were furnished as to which of these powers might be entitled intelligence most reasonably; but the suggestion was made of abolishing the word

altogether.

3. After this, the reviewer commits himself to a very serious statement. The book, he asserts, 'hypothecates' that the measurement of an ability is a function of two factors and then proceeds to replace this general functional relation by a purely linear one. In answer, he must be referred to the actual mathematical demonstration (appendix 111-v). This really contains no such hypothesis, no such replacement, nor anything like them; but instead, a full proof that when the correlations are what has been called 'hierarchical,' then the measurements can be expressed as linear functions of the two factors. As much may be said of the earlier proof supplied by Garnett.

4. Neither proof implies even Taylor's theorem directly. Such an implication is only indirect and occurs only to the extent that this theorem may underlie the significance of the whole theory of correlation and even of 'normal' frequency. In the book I ventured to throw out the suggestion that the

theorem may be thus implicated in the theory of correlation. But I do not press this matter for the present. I only mention it here as I wish to admit trankly that the book did not make this distinction between direct assumption and indirect implication

nearly clear enough.

5 The reviewer's next point is that a certain important quantity called the 'tetrad difference' was assumed by the book to have a normal frequency, whereas, he says, the data in the book itself prove that the distribution is not normal. In truth, the book never made any such assumption, instead, it showed graphically that the frequency is normal with good approximation.

6. He then objects that the mean tetrad difference had been made by me zero artificially. In truth, the mean of all the tetrad differences from any set of

variables is zero necessarily.

7. Then the reviewer lays down that the only real test provided of the agreement between theory and observation is a comparison of the probable error of the tetrad differences with their observed median value; and this test he considers not to have been passed with manifest success, since (in the case he picks out) the probable error was 0 061 and the observed median 0.062 (or, according to him. 0.060 and 0.058 respectively) The reply must be that such two values do manifestly 'fit' each other very well indeed. In last resource, all evidence of good fit between theory and observation consists in thus simply juxtaposing the two values and seeing whether they are nearly equal. Certainly not often is the result more favourable than the above one

8. In truth, however, this is by no means the only real test possible or provided. In statistics the probable error is compared, not only with the median of the observed values, but also with each of these values separately. This is what had been done throughout the book in treating the entire mass of available data published on the subject by the multitudinous investigators (including those belonging to the opposition party itself). The result was to show that whenever any tetrad difference did become excessive, then there were always good psychological grounds for it being so; the circumstances of the case were such as to require by theory that this particular tetrad difference should not be zero.

9. The reviewer closes by remarking that a better way to approach the problem would be to consider that, if we could assume the probable errors of the different tetrad differences to be mutually independent, then "We should . . . conclude that the new . . . theory, so far from being in 'striking agreement' with observation, signally failed." To this the answer is that, since any such assumption of independence is obviously quite wrong, the advantage of this new way of approach or even the point of suggesting that then the theory

would fail—is not evident.

Let us, however, now consider how far the present occasion can be utilised for converting mere wrangle into scientific progress The cardinal points (3) and (6) are matters of pure mathematics; they therefore can and should be definitely settled Unless, then, the reviewer is convinced by the foregoing remarks, Unless, then, I suggest that an impartial committee be appointed to adjudicate upon these two points and to report m this journal. As for the machinery of appointment, perhaps it could be done by a joint meeting of representatives of the Mathematical and Psychological Sections of the British Association. Points (1), (2), and (5) are misapprehensions which a closer study of the book ought easily to remove. But should the reviewer, after having heard my own account of what

I wrote and meant, still insist that his version is more correct, then these points too might be submitted to the committee. As for points (7) and (9), these, I hope are already sufficiently obvious On the other hand, point (8), involving as it does every part of the book and the whole of cognitive psychology, does not appear to be capable of summary settlement. Since here the crux is far more psychological than mathematical, the issue must be left to the eventual consensus of the general body of psychologists.

C. Spearman.

71 Kensington Gardens Square, W.2

The review in Nature of Prof. Spearman's book stated precisely what was possible in a critique which must not be of mordinate length. The review of the work took what its author in his present communication considers the kernel of his researches and of his recent book, namely, the hypothetical g and s, and considered whether Prof. Spearman was justified in making such sweeping claims for the hypothesis of a general and specific factors. The reviewer held, and still holds, that whether that hypothesis be verifiable or not, the data hitherto cited in favour of it are far from demonstrating its truth. In reply to Prof. Spearman's numbered statements the reviewer wishes to make the following counter statements.

(1) The general complaint that the actual data by which the conclusions in the book can be tested are not provided is correct. It took weeks of work to reproduce the frequency data for tetrads on which the chief arguments in chap. x. are based. When this was done the extent of the agreement was found to be not such as appears in the book itself.

(2) The reviewer's opinion that it is easier to criticise definitions than to provide them will be amply illustrated—at any rate to a physicist—by a study of chaps. ix. and xxiii. of "The Abilities of

(3) and (4) The reviewer can only repeat his assertion that Prof. Spearman has assumed that the functional relation is a purely linear one. The direct appeal to the lowest terms of a Taylor's series is made on p. v, and an indirect appeal to lineanity in pp. in-v of the Appendix to which Prof. Spearman now refers The statement that Taylor's theorem underlies the whole theory of correlation is in-

(5) On p. 146 Prof. Spearman has the following words, beneath a diagram showing a normal frequency curve superposed on a series of rectangles. "This time the two distributions, curve and rectangles, far from being totally discrepant as before, display instead one of the most striking agreements between theory and observation ever recorded in psychology" (Reviewer's italics). The author's words clearly denote that the curve corresponds to theory and the rectangles to observation. If they do not, what is the 'theory' which so strikingly corresponds to observation? It cannot be the two numbers given under the diagram, for one of them depends again on the normal curve.

If the frequency be not a normal curve but a curve which really depends on the individual series of tetrads, what is the meaning of talking about discrepancy 'between other tetrad distributions and the normal curve? A 'discrepancy' can only exist if a theory be known, and if Prof. Spearman's theory be not that of the normal curve, he has no measure of discrepancy. What is his 'theory'?

(6) The reviewer did not object to Prof. Spearman

making his mean of tetrads zero, by taking each one first positive and then negative, but what he pointed out was that having done this and got a symmetrical curve, Prof Spearman in every case was depending upon the value of a *single* constant of this artificially symmetrical distribution to test the accordance of theory and observation. No frequency distribution is defined by a single constant.

(7) This should read of course the "only real test provided" by Prof. Spearman; there are many other possible tests, so soon as we know definitely what his theory of tetrad distribution really is. The terms 'probable error' and 'observed median' appeal directly to the theory of a normal distribution. Values such as 0.060 and 0.058 may or may not be in agreement It depends entirely on what the probable error of their determination may be. Read in hectometres, the average statures of Englishmen and Frenchmen are 0 017 and 0 016 respectively. Do these "manifestly fit each other very well indeed"? Prof. Spearman writes: "In last resource, all evidence of good fit between theory and observation consists in thus simply juxtaposing the two values and seeing whether they are nearly equal. Certainly not often is the result more favourable than the above one." The reviewer ventures to think this remark is erroneous. The true statistical theory consists (i) in deducing a correct arithmetical result from the data, (11) in propounding a correct and comprehensive theory, and (in) in testing by the theory of errors whether the deviation between observation and theory is or is not probable on the basis of random sampling In all three points, in the opinion of his reviewer, Prof. Spearman has failed. His arithmetic is not always, but is often incorrect —his theory of what the variation of the tetrad distribution should be is incorrect—and he never concerns himself with the probable error of the difference between his theory and his observations. In the case of the statures cited above, the probable error of the difference is of the order 0 0002, and this is precisely what occurs in a number of Prot Spearman's cases—three (and sometimes two!) significant figures are not adequate to reach the probable error of the difference, even if that difference were based on a satisfactory mathematical theory.

(9) The answer here is a perfectly definite one. Prof. Spearman looks at two numbers or at a graph and asserts, apparently by mere inspection, that they are in 'good approximation.' The reviewer holds that no such inspection is of any real scientific value; a numerical test of some kind to measure the extent of this agreement must be applied. Where in mere inspection does Prof. Spearman introduce the fact that his tetrads are correlated? How does he allow for it in running his eye over the graph? Is he not judging, as we suspect he must, that his curve fits well his rectangles, however those rectangles have arisen? To test this we supposed those rectangles not to have arisen from tetrads, and we find the fit for such a system of frequency is bad, not good. How does Prof. Spearman, by aid of a special s factor, determine that owing to correlation the eye alone can judge between the two cases and assert that the fit of curve and rectangles is good for tetrads, but would be bad for a series of intelligence quotients on different individuals?

Are we prevented from applying a test of goodness of fit to measurements on a colony of statoblasts because there exists a high degree of hereditary correlation between its individuals? The reviewer wrote in his notice of "The Abilities of Man" that the pages of NATURE could not provide adequate space for a full mathematical and statistical criticism of

Prof. Spearman's hypothesis. The first part of such a criticism is now at press, and will be published shortly.

The Reviewer

[Prof. Spearman has left England for the United States and will not return until January next. He desires it to be known, however, that he proposes to pursue the conflicting statements in this correspondence by means of independent adjudication, as suggested in the concluding paragraph of his letter.—Ed. Nature.]

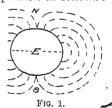
#### Possible Explanation of the Zodiacal Light.

The nature or origin of the zoduceal light is regarded as more or less of a mystery. Some have thought that the phenomenon may indicate the existence of a diffused ring of small particles in equilibrium and in nature somewhat like those of Saturn's rings, though more scattered and existing in very small amount compared thereto. This hypothesis assumes a stability which it is difficult to accord to such a ring

If we assume, however, that the coronal streamers from the sun, which apparently extend without limit of distance into space, are partly composed of or accompanied by fine particles propelled by the pressure of light, or even of fine solids from condensation of vapours arising from the solar atmosphere and expanding into a vacuum external thereto, we may form a hypothesis which seems to be consistent with the facts. The fine condensed particles would move into a vacuous space in substantially straight lines and would reach enormous distances from the solar body. As the spectrum lines of iron are prominent in solar light, it might be expected that in the space surrounding the sun fine particles of iron would constitute, in part, at least, those escaping streamers from the solar atmosphere. These particles would surround the earth and be extended in all directions therefrom.

If they be of the same or of sin dar nature to those which in my experiments are seen to line up in a magnetic field (the observations on the novel magneto-optical effect described in Nature of June 23, 1921, p. 520), then the zodiacal light, which is seen best at places near the equator and at times of vernal and autumnal equinoxes, might be explained as follows: The magnetic field lines of the

The magnetic field lines of the earth joining the north and south areas outside the earth would, at the equator, he sensibly parallel to the earth's axis, but at a great height, on the average, above the surface of the earth. This is illustrated in the subjoined diagram (Fig. 1), which indicates the general trend of the earth's



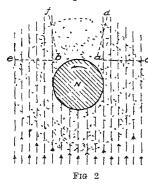
magnetic field (one side only) all around the earth m the space about it

The dots in Fig. 2 do not represent floating particles, but are intended to show only that if one could look at a pole of the earth from a great distance and see a section through the equatorial plane, the lines of force of Fig. 1 might be indicated as dots in the equatorial plane. Now let the sun's rays be from below; it will be seen that they intersect the direction of the magnetic lines at nearly right angles. Now, further, let us by some means render visible in the polar beam the magnetic field about the earth; it will become apparent that it will be best seen by observers after twilight at night and before twilight in the morning—best at the time of the equinoxes and best in the tropical night. On the average, the observer placed at about a or b looking upward, will

be well placed for such observation, and the column of light will extend from c to d on the evening side, and from e to f on the morning side, or over an angle of about  $60^{\circ}$  altitude, more or less

It may, therefore, appear as a plausible hypothesis that the luminous effect known as the zodiacal light or the *Gegenschein* may be of the same nature as that observed in the combination of magnetic field, light beam, and iron smoke from an arc, as described in 1921 in NATURE. If the zodiacal light is polarised in the same way as the light from the iron smoke is polarised, and undergoes the same variations by variations in the direction of viewing it, these circumstances might assist in identification.

There has been no opportunity to make any observations on this point As the luminosity of the zodiacal



light is low, although coming from a great depth of space around the earth, there would not need to exist, for producing the effect, more than an exceedingly small density in the iron particles concerned, a density perhaps millions of times less than in my original experiments on the magneto-optical effect. It has been shown also that the orientation which is the cause of increased luminosity in the light beam is

producible by a very weak magnetic field. That the direction of viewing is transverse to that of the light beam, and that the magnetic field lines are transverse both to the directions of viewing and the light beam, are significant facts. More and varied observations and experiments are certainly warranted in this fascinating field [see NATURE of Oct. 22, p. 581].

It will be seen that the hypothesis presented does not require any ring formation around the earth. It requires only that the general space surrounding the sun and planets contain an exceedingly small density of diffused iron particles, capable of being affected or oriented when in the magnetic field surrounding the earth, in which case they reflect the light of the sun to observers on the earth who are in favoured relation to them. Moreover, it may well be that the magnetism of the earth would tend to concentrate such iron particles, if any, in the space around it. If we have found a clue to the observed effects, further observations and investigations may confirm or oppose the hypothesis presented.

Lynn, Mass, Sept. 1.

#### The Fields of Force in the Atmosphere of the Sun.

While appreciating M. Deslandres's concluding paragraph of his letter in Nature of Oct. 8, and reverting first to the problem of the equal spacing of magnetic disturbances, synchronous with corresponding spacing of solar longitudes, I am afraid my studies, to which he kindly alludes in Comptes rendus for Sept. 1926, came to a stop for reasons of the statistical material I up to then could work upon, failing me. Nor can I dispose of the required magnetic recording apparatus of the kind used at Meudon, and I was wholly confined to the Greenwich spot records, and to my own observations of eruptive phenomena either at the limb or on the disc. The first diagrammatic representation of this phenomenon which I made covers the minimum period, section from July 1913

to Dec. 31, 1914, and I found that my method for a maximum activity period resulted in great diagrammatic complication, not to say confusion. All the same, I felt from the first convinced that I was by no means dealing with an accidental phenomenon, and I am therefore very hopeful that the method used at Meudon will ultimately be completely successful.

M. Deslandres's proposition of an interior solar sphere, rotating like a solid, is very fascinating, and has, as an a priori assumption, many points of merit, but on the other hand also raises other difficulties. One of these is how to reconcile the equatorial acceleration with a deeper seated level, which rotates with equal angular speed in all latitudes. What becomes of the striking independence of activity for the two hemispheres, when for months at a stretch scarcely a spot, or a substantial prominence, appears in the north, or in the south? Certainly the observational fact remains, that pronounced activity may be confined for long periods within a very limited range of longitude and latitude; but even then great variations occur, which seem to preclude the idea of stationary eruptive, even intermittently eruptive, volcanoes. Diagrams I have made, covering many years, show these latitude changes for successive rotations perfectly plainly. At Stonyhurst they carry on a method of tabulation, which shows the changes in longitude and latitude on the same diagram. M. Deslandres offer a physical explanation of these changes, retaining the interior sphere which in his opinion gives birth to the solar spot and rotates as a solid would?

M. Deslandres refers to the difficulty of explaining the much lower temperature of solar spots. Nothing has occurred since I began to observe the sun thirty years ago, which upset my initial conviction that the evidence of the spectroscope in this respect is misleading. It should be remembered that when examining the sunspot spectrum, we allow combined light to pass mto the instrument, not only that radiated by the spot-umbra and lower down, but also from great altitudes above the spot, all in the direct line of sight. Now my contention is that heaped up above the spotumbra and its vicinity there are the gases of the uppermost and coolest layers of the sun's atmosphere, as in fact the photographic representations of the solar vortices intimate. These photographs receive their 'design' from the dark absorptively acting filaments at great altitude, converging and descending towards the spot in precisely the same way as the cloud trunk does in the terrestrial tornado, or in the waterspout phenomenon. The trunk of the solar tornado can be seen directly in many cases of active solar spots and gives rise to the 'claw' effect so well illustrated in W. C. D. Whetham's book, "The Recent Development of Physical Science," but the spectroscopic explanation is erroneous, as given on page 308. All this points directly to the screening from the terrestrial observer of the umbral level by a concentration of relatively cool gaseous masses above the spot. I have yet to see the observational, or physical, refutation of the late Mr Wilson's temperature measurements of solar spots carried on at Daramona in 1895, which indicated the spot radiation at the limb to be relatively higher than when the spots were central. I submit that if M. Deslandres dismisses the theory of sunspots being cooler than their surroundings, at the level of the photosphere, he will find several problems easier of comprehension and explanation.

Nor do many phenomena in connexion with prominences admit of the dogma, that the sun is a truly gaseous body. Such types of eruptive prominences as the fascinating, clean-cut parabolic jets, are irreconcilable with a genuine gaseous state, and point

at best to a quasi-gaseous-cum-quasi-liquid interior

The magnetic field seems to me to be induced mechanically by the whirling vortex, and I have seen on more than one occasion on the sun's limb an exact and complete representation of the converging luminous  $H_{\alpha}$  filaments, as represented in Dr. Stormer's theoretical diagram, page 31, No. 109, of the Mount Wilson Contributions, these luminous lines strikingly representing the magnetic lines of The creation of a magnetic field about sunspots by the vortex appears to me a direct result of the violent temperature changes which are going on Thus, for example, the conduction of hot steam into cool water means abrupt condensation and is accompanied by strong electric effects, particularly noticeable when the vessel containing the cool water is fairly well insulated. I have often wondered why this simple experiment has not been followed up and made use of industrially. Once electric effects are admitted in connexion with, and due to violent temperature changes, it does not appear very difficult to understand the possibility of attraction and repulsion effects also. ALBERT ALFRED BUSS.

22 Egerton Road, Chorlton-cum-Hardy, Oct. 12.

#### Flame and Combustion.

As a result of investigations on the effect of 'antiknock' compounds on the ignition of hydrocarbons, it was concluded that the combustion of hydrocarbons was autocatalytic and that the 'antiknocks' delayed oxidation by destroying the catalyst. It was further pointed out that these processes of catalysis were connected with the peroxidation of the fuel and of the antiknock, and that the course of the catalysis depended on the oxygen concentration (Jour. Inst

Pet. Tech., pp. 244-280, 1927).
The effect of carbon disulphide on ether-air mixtures (cited by Dr. White in NATURE of Jan. 8, 1927), its effect also in raising the igniting temperature of petrol and in preventing 'knock' in engines in spite of its inflammability, can be ascribed to similar actions. Sulphur (particularly if combined with a reducing radical) can act as an 'antiknock' in the same manner

as selenium, though to a less degree.

One is led to expect that the effect of water and of hydrogen on the combustion of carbon monoxide—air mixtures would be a similar case of catalysis, in which the peroxidation would be influenced by 'antiknock' compounds. The first experiments made to test this point were unsuccessful; Mr. Gates and I found that lead tetraethyl did not influence the combustion of carbon monoxide—hydrogen—air mixtures (except sometimes, it seemed, in explosions of a vibratory character). It was thought that the lead tetraethyl vapour probably did not have time to be decomposed before reaching the zone of combustion and could therefore not modify the flame speed. This surmise appears to be correct; Mr. Goodey and I have found that iron carbonyl, which decomposes at a lower temperature than lead tetraethyl, modifies the combustion of carbon monoxide—hydrogen—air mixtures very considerably.

The object of this letter is to direct attention to the importance of the study of the stages of combustion which precede inflammation—an importance to which Prof. Bone, from another point of view, has directed attention by his recent work on the explosion of methane—oxygen mixtures (Proc. Roy. Soc., 114, p. 442; 1927). The process which goes on in the body of the gas is catalytic and has a great influence on the subsequent ignition of the mixture, and is even important in the narrow region of heated gas immediately in front of an advancing flame. A EGERTON.

Clarendon Laboratory, Oxford.

In conjunction with Mr. D. L. Hodge, for some time past I have been studying experimentally the combustion of  $2CO + O_2$  (moist and dry) in a steady high tension direct current discharge, and the experiments have resulted in some new observations which seem to have an important bearing upon the function of steam in the combustion of carbonic oxide. soon to communicate a detailed account of them to the Royal Society; meanwhile, in view of the general interest in the subject, we should like to make the

following brief statement of the results

In such a high tension direct current discharge, combustion may be wholly localised either (a) at the cathode or (b) in both the cathode and the positive column zones. By the methods which we have employed, we have been able to study the influence of moisture on both the cathodic and the positive column combustion. Our results have shown that in the cathode zone, where the fall of potential is very steep and the ionisation accordingly intense, the rate of combustion is quite independent either of the gas pressure or of the presence of moisture, but is proportional to the current passing, that is, to the number of ions arriving at the cathode per unit of time. In this region, the presence of moisture, so far from assisting combustion, slightly hinders it, owing to its diluent effect. Thus a sulphuric acid - dried 2CO + O2 mixture combined in this region at a rate about 15 per cent. faster than did the same mixture when saturated with water vapour at 17° C.

In the positive column region, however, where the potential gradient is slight as compared with that of the cathode zone, the presence of moisture greatly

accelerated the combustion.

It would thus appear that, whereas moisture may accelerate combustion in a  $2\text{CO} + \text{O}_2$  mixture in a region of comparatively weak ionisation, it has no influence, other than that of a diluent, in a region of sufficiently intense ionisation. Such results confirm the conclusions already drawn by Prof. Bone from his experiments, namely, that moisture is not essential to the combustion of carbonic oxide, and that (in cases where it accelerates the process) its rôle is electrical G. I. Finch. and not chemical.

Department of Chemical Technology, Imperial College of Science and Technology, London, S.W.7.

In commenting upon our previous letter in Nature, Oct. 22, Prof. Armstrong stated that, in comparing the heats of combustion of carbonic oxide and hydrogen in flames, he had taken into account the keat of formation of water, not that of hydrone (steam), which can only mean that he supposes water (not steam) to be formed in flames. This being so, will he then kindly vouchsafe us an answer to the question put to him in our letter, namely: Is there, indeed, any evidence that not 'hydrone' (steam) but something much more complex and 'hydronolic' (water) is formed in flames? For we want to know what his answer is before deciding whether or not it would be safe for us to accept (as he suggests) the guidance of his 'imagination' whilst wearing our 'thinking caps.'

WILLIAM A. BONE. D. T. A. TOWNEND.

Oct. 31.

#### Absorption of X-Rays in Various Elements.

Recent investigations of the absorption of X-rays m different elements (aluminum, nickel, copper, silver, and platinum) and extended over a great region of wave-lengths (0 7 to 12 A.), using strictly monochromatic radiation, have led me to the following general laws:

1. The jump  $\delta_K$  of the absorption coefficient on passing the K-absorption limit is:

$$\delta_K = E_K/E_{L_1},$$

where  $E_K$  and  $E_{L_{\rm I}}$  are the energy-levels corresponding to the K- and  $L_{r}$ -levels respectively (see Siegbahn's "Spectroscopy of X-Rays," pp. 184-185). The total jumps at the L- and M-absorption limits are in the same way determined by the formulæ:

$$\delta_L = E_{L_I}/E_{M_I}$$
 and  $\delta_M = E_{M_I}/E_{N_I}$ .

2. If the absorption is calculated per electron  $\mu_{\epsilon}$ 

instead of per mass unit  $\mu/\rho$  ( $\mu_{\epsilon} = \frac{\mu}{\rho} \cdot \frac{M}{N \cdot L}$ ; M is the

atomic weight of the absorbing element, N its atomic number, and L the Loschmidt-number), it can be shown from my own measurements and from earlier investigations that  $\mu_{\epsilon}$  is a function of the product  $N\lambda$  for every branch of the absorption curve.

3. By using these two laws it is possible to give in a diagram, with  $\mu_{\rm e}$  and N\Lambda as co-ordinates, one single continuous curve for the absorption at all wavelengths and for all elements.

The new measurements and the results here mentioned will be given in a doctor's thesis (now in print) at the University of Upsala.

Edvin Jönsson.

Physical Laboratory, Upsala (Sweden), Sept 15

#### The Electric Arc in High Vacuum.

WITH reference to the interesting letter by S. Ratner on the electric arc in high vacuum, published in NATURE of Oct. 15, p. 548, this type of arc has been observed previously by me under conditions very similar to those used by the author (see *Phil. Mag.*, vol 2, p. 796; 1926). I found that it could be excited in residual gases or in hydrogen at very low pressures, provided that an initial electrical discharge was sent between one of the iron electrodes and a

The radiation emitted showed no trace of the iron lines, but gave a bright continuous spectrum together with lines and bands from the various gases present. There were really two types of arc-the ordinary arc, where the current rose in some cases above 10 amperes, and a brilliant glow during which a small current passed between the electrodes. Both these types could be excited at such low pressures that there was no trace of luminosity due to the electrical discharge.

Such an intermittent are would form a convenient type of relay if the initial electrical discharge required were feeble, and if the arc would strike each time that this feeble discharge was sent through the tube. It was found, however, that these conditions were not fulfilled, the state of the electrode surface being an important factor.

The phenomenon is very interesting, and considering that the electrodes are cold, there seems to be no satisfactory explanation. F. H. NEWMAN.

University College, Exeter.

Psychological Dissociation as a Biological Process.

In "Instinct and the Unconscious" the late W. H. R. Rivers suggested that the mechanisms of psychological dissociation familiar in human psychopathology have played a large part in the adjustment of the behaviour of animals during metamorphosis and in other changes of environment. The subject clearly had a great fascination for Rivers, and he reverted to it in a later paper ("Psychological Dissociation as a Biological Process," Scientia, vol. 35, p. 331; 1924). The purpose of this letter is to direct attention to the significance of a discovery which goes far to confirm these speculations.

In a recent paper on "Loss of Memory accom-

panying Metamorphosis in Amphilia "(P.Z.S., pt. 1, p. 155; 1927), Major S. S. Flower records that salamander larvæ tamed to feed from the hand lost all their tameness at metamorphosis and had to be trained again de novo. In the main this abrupt disappearance of larval behaviour is just what Rivers predicted, though it appears to be correlated with the internal rather than the environmental changes of metamorphosis, the salamanders being apparently still partially aquatic when the change occurred.

It is much to be hoped that Major Flowers' most interesting observations will be extended and amplified. One would like to know, for example, if premetamorphic training facilitates or prejudices the acquirement of the behaviour after metamorphosis. Some quantitatively observable conditioned reflex would be invaluable in the investigation.

In conclusion, it may be emphasised that the abrupt change corresponds more to repression (= suppression of Rivers) than to gradual growth out of a childish habit, and suggests that the former is, as Rivers suggested, a normal biological process not as Kivers suggested, \_ \_ confined to human pathology.

G. EVELYN HUTCHINSON.

Dept. of Zoology, University of the Witwatersrand, Johannesburg, Oct. 12.

#### Geological Survey of Uganda.

An unfortunate error has crept into the Annual Report of the Geological Survey of Uganda for the year 1926, whereby the reader is informed that Mr. A. D. Combe, of this Survey, is of opinion that there is a continuous succession through the Transvaal System into the Waterberg System in the Cape Province of South Africa. May I be permitted to make use of the columns of NATURE to correct this error? Perhaps readers of this journal who have copies of the report will kindly turn up page 32, delete line 34 and delete all of line 35 except the last

word and the comma in front of it, and re-write thus: "Mr. Combe suggests that in the Katanga Province there may be a continuous conformable succession through the equivalents of the Transvaal and Waterberg Systems without an unconformity, similar to the grand conformable succession, in parts of the Cape Province, through the Cape and Karroo WILLIAM C. SIMMONS. Systems."

# Green Lightning.

DURING a thunderstorm last night, a flash of lightning started from the top white, and about half-way down turned to a vivid green. Possibly I am very unobservant, but I do not remember ever to have seen green lightning before. Y.M.C.A., H. H. STEPHENSON.

Brantford, Ontario, Oct. 7.

# The Germplasm and its Architecture.1

By Dr. F. A. E. CREW.

THE individuals of a generation die, but life is transmitted to its successor through the exercise of the function of reproduction handing on of the torch of life, in the more highly organised forms, consists in the union of the gametes, egg and sperm, to form the zygote, the new individual and the next generation, specific to the highest degree and embodying all the possibilities of individual development and of racial perpetuation. Each of the sexually distinct parents contributes but a single cell, so minute as to be far beyond the limits of the unaided eye, yet these gametes are the only material link between the generations, and across this, the narrowest of bridges, everything organic that one generation can receive from its predecessor must pass. The zygote exhibits none of these details of structure and of function which, when the individual has assumed its definitive form, will enable the observer to describe and to classify it, yet in this fertilised egg there must surely be something that predetermines much of the individual's future morphological, physiological, and psychological limitations.

That offspring do in general resemble their parents is so familiar a fact that its significance is either overlooked or over-emphasised. It has been accepted, without wonderment, that a multitude of characters is faithfully transmitted from generation to generation; that like tends to beget like; that it can be predicted confidently that every individual conceived will sooner or later exhibit those details of form and of function which characterise the species. the race, even the family to which it and its relatives belong. The doctrine of homogenesis still satisfies the biologist. It has equally long been recognised that no son is the 'carbon copy' of his father, that each individual is the first and the last of its identical kind; that indeed variation is universal. It may be assumed that out of accumulated anecdotes concerning the similarities and dissimilarities in characterisation exhibited by related individuals, there soon arose the notion that in their distribution there were suggestions of an orderliness, a regularity, that many characters were indeed being inherited and that the mode of their inheritance was not a haphazard affair but was surely subject to certain rules. Thus it would soon become inevitable that the human mind, in its inherent desire to trace and to describe order in Nature, should seek some mechanism which in its functioning could account for this observed orderliness. A consideration of the observed facts of organic inheritance enabled man to form a general theory of inheritance, a speculative thought-model of what the architecture of the hereditary material might be.

The question to be answered was, "How is it that like begets like?" In the latter half of the eighteenth century it was customary to appeal to

vires formativae, hereditary principles, hereditary tendencies, by the aid of which the seed grew into the likeness of its parents. In an age when materialism was not gross and when the microscope was most imperfect, it was inevitable that scientific men should resort to merely verbal explanations, which at best were gestures of respectful ignorance and of admiration. But improvements in techniques and additions to knowledge quickly eroded

such purely metaphysical hypotheses.

During the seventeenth, eighteenth, and the earlier part of the nineteenth centuries, the most favoured explanation of the facts of inheritance and of development was some form of the theory of preformation and evolution According to this, the egg, or the sperm, contained within it a perfect but miniature model of its parent, preformed though invisible, which required only to become unfolded, evolved, in order to reveal itself. This theory of ontogeny was extended to include phylogeny also, and it was taught that within this miniature was a second, and within this a third, and so on in increasing numbers until all the future generations were supplied; within mother Eve it was estimated were some two hundred thousand million homunculi, one within the other, like the components of an infinite juggler's box of which there is no end. Ovist and animalculist debated violently, yet both were agreed in this, nothing was generated, and what was thought to be generation was but merely the enlargement of that which had pre-existed in an invisible form. Haller it was who declaimed, "Es gibt kein Werden"—there is no becoming—and the theory held sway until it staggered under the blows of Wolff's demonstration of the gradual development of the apparently simple into the manifestly complex. Wolff demonstrated that development was epigenetic, taking the form of a true series of transformations, and was not merely the enlargement of what previously had been invisible.

Just, however, as the preformatists could not easily account for the origin of their miniatures, so Wolff was unable to explain the demonstrated fact that the end-result of epigenetic development was an individual similar in characterisation to its parents, save by an appeal to the aid of a vis corporis essentialis by which the plastic organic material controlled its own destiny. Wolff was not unique in this; it has ever required the severest intellectual ascetism to banish from the scientific mind this tendency to explain by an appeal to a metaphysical conception, and since his time this inherent force has been recreated by many who have been at pains to give it another name; purposive striving, emergent evolution, creative evolution, are examples, for man ever creates his gods and imprisons them in the machines that he invents.

These theories in their sequence were signposts along the road we are travelling, for out of them emerged the firm conviction that the future in-

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 $<sup>^{\</sup>rm 1}$  Evening discourse delivered at the Leeds meeting of the British Association on Sept. 5.

dividual must be materially implicit in the gamete. and that not only did this single cell contain the rudiment of the next generation but also those of all succeeding generations as well. Soon the conception arose that the germ-cells were distinct from the rest of the body; that they were to be looked upon as centres of contributions from the different parts of the body. The central problem of heredity came to be that which was concerned with the manner in which the various heritable qualities of the individual got into the germ-cells produced by that individual Theories of pangenesis, which had flourished from the time of Democritus, were revived and extended but soon gave ground as the conception of germinal continuity, finding support in the newer facts of It had been shown cytology, gripped the mind that in certain instances it was possible to dis-tinguish between those cells of the segmenting zygote which were destined to become the reproductive organs and those which were to become the body of the individual. The distinction between the ontogenetic and the phylogenetic became more and more emphasised as time went on, and soon it became evident that in the fact of material continuity between the reproductive elements of generations must be found the solution of the problem as to how it is that like tends to beget lıke.

To Weismann is mainly due this replacement of pangenetic theories by genetic. He taught that the germ-cells were to be regarded merely as parts of an unbroken line of germplasm, the bearer of the heritable qualities; that this germplasm, in certain circumstances, usually the union of two of its constituent germ-cells, frothed up and produced a great excrescence, the somatoplasm, the body of the next generation, and continued its existence therein, that the germplasm was immortal, the body mortal; that the germplasm had existed from the very dawn of life, whereas the body was formed afresh in every generation, that when the zygote divided, some of the resulting cells were set apart at once and took no further part in the building of the body, but remained, later to become the germ-cells of the individual

Weismann postulated that what is actually continuous is the germplasm of definite chemical and specific molecular constitution, that a continuity of actual germ-cells is rare, but that a continuity of intact germplasm is the rule. According to such a genetic theory of inheritance, an individual is like its parents, not because it is produced by them but because both parent and offspring are produced from the same stock of germplasm. The somato-plasms of father and son are developments at different times from one and the same continuous stream of germplasm. Organic inheritance, all that the individual possesses in virtue of the hereditary relationship, implies a rhythmical repetition of a definite, and on the whole, similarly repeated series of events leading to the production of an individual which liberates germ-cells capable of initiating the same process.

The problem of organic inheritance thus became

restated. It was now concerned with the manner in which the heritable qualities of an individual were represented in the germ-cells which in their union produced the individual; the need for critical experimental investigation of the problem of heredity and variation was recognised and the stage was set for the re-entry of Mendel. When the records of his work of some forty years before were brought to light in 1900, it was recognised that in them was confirmation and extension of the essentials of Weismann's hypothesis, but that no longer was it necessary to invoke a hypothetical mechanism for the distribution of the hereditary factors, for by this time independent cytological investigation was disclosing a satisfactory mechanism within the living cell.

Mendel had taken for his problem the question as to the exact manner in which the definite and true-breeding varieties within a species are related one to the other. He considered the individual not as a unit in inheritance, but concentrated his attention upon the mode of inheritance of pairs of sharply contrasted characters. The method he adopted was that of hybridisation, and he kept accurate pedigree records showing the ancestry and the characterisation of each individual. He counted the number of individuals in each generation and the numbers of dissimilar kinds, and was able to give an exact mathematical statement of his results. His was the first attempt to reduce the phenomena of inheritance to a measurable basis, for he employed the exact quantitative methods that scientific discipline demands. The man, the method, and the material made discovery certain. He found that in the case of every one of the seven pairs of contrasted characters of the culinary pea with which he dealt, the mode of inheritance was the same. Out of his experimentation there emerged clearly the verifiable fact that when one or more pairs of alternative characters are involved in a breeding experiment, there is in the second hybrid generation an orderly reappearance of these characters in definite numerical proportions.

Mendelism is a scientific theory relating to the distributive mechanism of organic inheritance which, like most other hypotheses of this kind, postulates the existence of a number of individual particles of substance-factors—in the germplasm each of which in its action influences the development of some particular character. It does not require that these particles shall be concerned solely with hereditary transmission. It demands that in respect of any particular character the individual must receive from its parents, one from each by way of the gamete, two factors, either similar or dissimilar according to whether or not in the respect of this character the parents were alike or different. It requires that when the individual in its turn elaborates its reproductive cells, into each ripe gamete there shall pass one or other, but not both, The gamete can contain but a of these factors single set of factors; the zygote a double set, and of these one set shall have been received from each parent. Thus the zygote may be hybrid in respect of a character or characters since one or more pairs of factors in its constitution may consist of dissimilar mates: the gamete, on the other hand, cannot be hybrid, since factorially it is constitutionally simplex. The theory postulates that the association of dissimilar factors in the zygote is not attended by any adulteration effect upon them.

The Mendelian method of character analysis, ardently pursued during the first decade of the twentieth century, made it perfectly clear that if there were actually such a thing as a material basis of organic inheritance, if the germplasm did exist in fact, then in the cell there must be some unit which is structurally continuous through all cell divisions from the first cleavage of the fertilised egg to the liberation of the ripe gametes by the resulting individual; that these units must be present in duplicate in the zygote; that they must segregate into single components at some point before the functional gametes are finally formed, and that in the zygote these units must be present in pairs.

As was to be expected, it was not long before results were obtained from breeding experimentation which demanded extension and modification of the theory as originally promulgated by Mendel Mendel's second law of the independent segregation and recombination of factors, for example, was found by Bateson and Punnett not to apply invariably. In several instances this free assortment was found to be more or less absent, and characters in their transmission from generation to generation exhibited the tendency to remain together. In appropriate matings and in those cases in which such linkage was evidenced, linkage

proved to be incomplete and the percentage of recombination classes was found to be constant under controlled and stable conditions of experimentation and to be characteristic of a particular mating. With greater experience came the power to predict the percentage of such recombination classes in any experiment involving characters which exhibited this linkage relationship and such prophecy has been abundantly verified, and no exceptions so far have occurred to the rule. Upon this general result the hypothesis of the linear arrangement of factors within the germplasm is based.

As a result of this more recent experimentation, the factorial theory of organic inheritance has become modified and greater have become the demands which must be made upon the germplasm. It is now generally accepted that the hereditary characters are referable to paired elements in the germplasm which are held together in a definite number of linkage groups; that the members of each pair of elements separate when the germ-cells mature, in accordance with Mendel's first law, and in consequence each gamete comes to contain one set only; that the members of different linkage groups assort independently, in accordance with Mendel's second law; that an orderly interchange—crossing-over—takes place at times between the elements in corresponding linkage groups; and that the frequency of crossingover furnishes evidence of the linear order of the elements with respect one to another. The germplasm in its nature and architecture is now required to be such as can accommodate the facts of linkage, of crossing-over, and of the linear order of factors. (To be continued.)

# Standards of Performance of Heat Engines.

THE discovery of the interchangeability of heat and mechanical work has been followed by and mechanical work has been followed by progressive efforts to attain the maximum ratio for the efficiency of conversion of the former into the latter. It is significant of the limitations which attach to such conversion, and the remoteness of a complete solution, that after a century of progress we are still striving to express this efficiency as the ratio of a ratio. This reflection is suggested on perusal of the report recently issued by the Committee of Heat Engine Trials under the auspices of the Institution of Civil Engineers, one of the objects of which is to determine a suitable standard of performance, which shall have a known efficiency ratio, and to express the actual performance of an engine as a ratio thereof.

The limitations are well recognised. There are first of all those of a thermodynamic nature, which prescribe that within given limits of temperature the defect from perfect conversion cannot be less than the ratio of the minimum to the maximum absolute temperature; in other words, the maximum possible efficiency is given by  $(1 - T_2/T_1)$ ; this is known as the Carnot efficiency, belonging to a perfect heat engine working on such a cycle that

heat reception takes place at, and only at, the maximum temperature  $T_1$ , and heat rejection solely at the minimum temperature  $T_2$ 

at the minimum temperature  $T_2$ It might be thought at first that the quest for an intermediate ideal could end here and that this simple expression for the maximum efficiency thermodynamically possible would answer the requirements. But there are further limitations of a practical nature on account of which the Carnot efficiency ratio is still a long way removed preferred what can be obtained in practice, and it is pring a lower to soothe our baffled ambition by add at can actually be realised.

The nearest approach to the Csci g saturated steam. In the steam engine when usin at the feed water up the feed to boiler temperature, the verteeption takes place at a corresponding to the heat temperature, and, if we assume no losses by a condenser temperature. This this known as the condenser temperature. This this known as the carnot cycle. The only defined from the carnot cycle is in the replacement cess of elevating pression stage by the simpler protes.

the condensed water to boiler pressure in the feed The consequent almost complete elimination of negative work gives the Rankine cycle a great practical superiority, and the early success of the steam engine as a prime mover was largely due to its ability to work on this cycle with saturated

The Rankine cycle was therefore considered a more suitable standard of comparison than the Carnot cycle, and came into general employment by makers and users of reciprocating engines. It was adopted as the criterion of performance by the first Committee on Heat Engine Trials in 1898, and reaffirmed by the Committee of 1903-1905. The processes of the Rankine steam cycle are (1) reception of heat at constant pressure, (2) adiabatic expansion, (3) rejection of heat at a constant pressure and temperature, (4) restoration of the feed water to boiler pressure

With the adoption of superheated steam, an extension of the cycle was necessary, to include the superheating process, but since, when employing superheat, evaporation takes place at a temperature below the maximum of the cycle, the Rankine cycle becomes further removed from the Carnot cycle, in the sense that it does not follow the latter to the full realisation of the increase of efficiency made possible by the higher maximum

temperature.

In later practice it has become customary to speak of the Rankine cycle as though it were synonymous with a modified cycle in which the volume of the feed water is neglected, the work done in the cycle being then equal to what is known as the 'available energy' of the steam between its conditions at admission to, and exhaust from, the engine. As a standard of measurement of the efficiency of the engine itself there is much to be said for it, and the development of the turbine has familiarised us with the conception of an engine steadily extracting from the steam its available

Finally, the properties of steam have now been so thoroughly explored and reduced to a thermodynamically consistent basis, that it is a comparatively simple matter to calculate the available energy of the steam even under complicated conditions of supply such as are entailed by the modern practice of bleeding steam from turbines to heat the feed water, and of reheating the steam at intermediate stages of its expansion. The Committee, which has just issued its report, has accordingly recommended referring the performance of the engine to the available energy in the steam according to the conditions of its utilisation, which energy can be calculated by well-known

While this serves excellently for the appraisement of the engine performance, it must not be overlooked that attention has been diverted from the heat engine proper and confined to that part of it only which carries out the process of expan-The heat input as evaluated in the report is also different from the heat input of the Rankine cycle, in that it includes the small

amount of 'total heat' put into the feed water by the feed pump. The efficiency thus calculated for the standard of performance is no longer that of the Rankine cycle heat engine.1 For moderate pressures the differences are small, but they become appreciable when high steam pressures are employed.

A similar approximation is not possible for the internal combustion engine, since in this case the negative work is considerable It results that the difficulty of finding a satisfactory standard is increased. The Committee has re-affirmed the conclusions of the Committee of 1903, which recommended the adoption of the air-engine standard, namely, an engine working with a perfect gas of the same density as air and operated between the same maximum and minimum volumes as the actual engine. This recommendation of the earlier Committee was qualified by the admission that amendment might be required later on the acquisition of more accurate data regarding the variation of specific heat with temperature.2 Sir Dugald Clerk has pointed out that the practical thermal efficiencies are of the order of 70 per cent. of the air standard efficiency for most economical mixtures, and a note in the new report discusses the effect of variable specific heat upon the efficiency of the air cycle, giving curves for various types of engine. The correction factors so introduced are considerable and vary with the heat input, that is to say, with the mixture strength of the actual engine and also with the type of engine.

The Report recently issued is, however, a veritable mine of information. In addition to the discussion of the thermodynamics of the subject in the introductory notes, forms of record are given making available to users of heat engines and to research workers authoritative methods of recording and reducing the results of efficiency and capacity trials. The Report takes within its scope boilers and steam engines for land and marine purposes, gas producers, gas engines. heavy oil engines, and petrol or paraffin engines. Schedules are presented for each section indicating in comprehensive detail the various measurements to be made, each leading up to a heat balance account for the plant under test. The value of these schedules is enhanced by copious notes for the guidance of the engineer

employing them.

A valuable addition to the Report is a series of appendices, dealing with instruments and methods for the most important of the measurements that In virtue of all this additional are required matter, this Report on the tabulation of engine trials has been elevated to the rank of a text-book of the subject, and a useful work of reference.

<sup>1</sup> If H', H'' be the total heat at beginning and end of adiabatic expansion, h' the total heat of water at condenser temperature and pressure, standard efficiency ratio as adopted  $= \frac{H' - H''}{H' - h'}$ , efficiency of Rankine cycle  $=\frac{H'-H''-w}{H'-k'-w}$ , w being work (in heat units) of the feed pump See Callendar, "Properties of Steam," p 219
<sup>2</sup> Minutes of Proceedings of Institution of Civil Engineers, vol 162,

# Rothamsted Experiments.1

PERIODIC summary on the work at the Rothamsted Experimental Station is an essential if teachers and others are to keep in touch with its activities. Its place is between the fleeting impressions of a summer-day visit, and the detailed monographs and specialised publications. This is recognised in the preparation of the report, and one can obtain in brief the more outstanding results, in this case for the years 1925 and 1926. If the critic sometimes feels that 'research in agriculture' is merely a phrase, he will find that it is a reality at Rothamsted.

The many-sided activities of the station of to-day are at once apparent from the staff-list, and one recalls the few workers and the meagre equipment of the Rothamsted of Lawes, Gilbert, and Warington. Yet even then the reputation was being made that now attracts temporary workers from all parts of the world. The large proportion of biological workers is noteworthy as evidence of the recognition of a living plant and a soil where organisms play an important part. There has also been an increase in the departments concerned with statistics and conducting of field experiments. The activity of the director and the staff is evident from the number of papers published, and the student struggling to keep pace with the present large output of agricultural literature will be grateful for the terse summaries of the more strictly scientific papers, extending to thirty pages of this report. Another direction in which the station has done valuable work is in organising conferences, which have been of the nature of symposia on particular aspects of agricultural science, or meetings of farmers with the staff and other scientific workers for the discussion of recent developments and their significance in agricultural practice. Then there are the extra-mural activities, such as organising displays for the Royal Agricultural Show and other exhibitions, and the work of the guide lecturer, who demonstrates the station's work to visitors and, during the winter months, delivers lectures to farmers' and other institutions on agricultural topics

The key-note of the earlier Rothamsted work may be described as propaganda on the use of fertilisers, but as these are now incorporated as part of ordinary farm practice, modern problems are concerned with details that are factors of prime importance in crop production The sixty-year experiments are still continued, but are amplified by being repeated in other parts of the country, and through more exact observations on the crop-plants. Thus it is no longer the work of a research station to persuade farmers to use artificial manures, but it is still a problem how to get the best value out of the manures. There seems to be good evidence that at Rothamsted and elsewhere I cwt. of sulphate of ammonia may be expected to give an increase of 20 cwt. in the case of potatoes, and 4 cwt. or 8 bushels for barley. The results for phosphates and potash are

not so regular, although the fertility of the soil will almost certainly decrease if these are not maintained.

The interaction of one manure with another is also being investigated. In recent years increased attention has been given to minerals not actually plant nutrients, but influencing growth; boron, silicon, and manganese have been subjects of recent papers. Experiments on chlorides show that muriate of ammonia raises the yield of barley, not by increasing the numbers of ears but by improving the yield of grains per ear, in other words, chlorides appear to increase the movement of food materials towards the grain. The nitrogen content of barley, so important in malting, has also been under experiment, and results are given.

Since 1921 sheep-grazing has been included in the programme, thus supplementing the original manuring of grassland plots where the results were limited in application because they were investigated for Grazing complicates the problem, hay yield only and the period of these experiments has been too short to allow of conclusive results There is evidence that the amount of soluble phosphates in slag is only a rough measure of its utility. Results bear out the recognised fact that good land does not show so much response as poor land, or as the report puts it: "Grassland is not readily improved by slag if an acre of it yields some 200 lbs. live weight mcrease in sheep; the striking results are obtained on land giving only 50 or less lbs. increase per acre "

Methods of field experimentation are being intensively studied, as shown by the number of publications dealing with these or including them in arriving at results. A new departure is the staff and field laboratory for making measurements on the growing plant, since it has been found that in this way more useful information is obtained than by using weighings at the end of the experiment alone. The figures obtained are now handled by the statistical staff to estimate error, etc. Reasons are given for the adoption of 'standard error' (p. 122), and the merits of 'the Latin square' and randomised blocks' are discussed (p. 28). The soil physics department indicates its attempts to amplify the empirical rules of cultivation into a science. The studies on soil resistance as measured by the dynamometer, are illustrated by a diagram of Stackyard field showing the easing in plough-pull after 'chalking'. Other problems bear on soil texture as distinct from chemical properties

Soil microbiology, another recent development, is briefly explained, including some applications in practice, namely, inoculation of legummous crops, partial sterilisation of soils, and fermentation of cellulosic materials to produce artificial farm-yard manure. Other departments are concerned with losses of crops, including studies on what is involved in the resistance of so-called immune varieties. Altogether the report is not merely informative, but is also strongly suggestive of possible lines for demonstration and research, hence it should be in the hands of all interested in the principles and practice of agriculture.

¹ Lawes Agricultural Trust · Rothamsted Experimental Station, Harpenden. Report 1925-26, with the Supplement to the "Guide to the Experimental Plots" contaming the Yields per Acre, etc. Pp. 156 (Harpenden: Rothamsted Experimental Station, 1927) 26 6d.

#### News and Views.

THE following awards have been made by the president and council of the Royal Society, and the King has approved the awards of the Royal Medals: The Copley Medal to Sir Charles Sherrington for his distinguished work on neurology; a Royal Medal to Sir Thomas Lewis for his researches on the vascular system, following upon his earlier work on the mammalian heart-beat; a Royal Medal to Prof. J. C. McLennan for his researches in spectroscopy and atomic physics; the Davy Medal to Prof A. A. Noves for his work in physical chemistry, especially on the subject of electrolytic solutions, the Buchanan Medal to Dr. Major Greenwood for his statistical researches and other work in relation to public health; the Hughes Medal to Mr W D Coolidge for his work on the X-rays and the development of highly efficient apparatus for their production.

AT the meeting of the Royal Society on Nov. 3, Mr. Stanley Baldwin was elected a fellow of the Society under Statute XII., which provides for the election of persons who "have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the Society." The following is a list of those recommended by the president and council of the Society for election to the council at the anniversary meeting on Nov. 30:-President, Sir Ernest Rutherford; Treasurer, Sir David Prain; Secretarics, Mr. J. H. Jeans and Dr. H. H. Dale, Foreign Secretary, Sir Richard Glazebrook; Other Members of Council, Dr. E. D. Adrian, Sir Hugh Anderson, Dr. F W. Aston, Dr. F. A. Bather, Sir Archibald Garrod, Sir Thomas Heath, Prof. A. Lapworth, Prof. J. C. G. Ledingham, Prof. F. A. Lindemann, Mr. J E. Littlewood, Mr. C. Tate Regan, Prof. A. C. Seward, Prof. G. Elliot Smith, Dr. T. E. Stanton, Sir Gilbert Walker, Sir James Walker.

THE Gallie race can boast of a long list of front rank and even alliterative mathematicians-Laplace, Lagrange, Legendre, Picard, Poincaré, Painlevé, to mention only a few—but M. Paul Pamlevé provides that rare combination of mathematical and political emmence that is almost without parallel. While the subject with which he will deal on Nov. 15 in his address at the Royal Institution on "Les conceptions modernes de la matière et de la science classique "will be primarily physical and philosophical, his mathematical energies have been devoted mainly to the purer aspects of that subject, although not exclusively so. Thus in his paper in the Bulletin Astronomique (1898) he made important contributions to the problem of three bodies, but the focus of his work has primarily been differential equations and the theory One of his earliest papers on the of functions singularities of functions, "Sur les lignes singulières des fonctions analytiques" (Comptes rendus, 1887), enunciates a number of important theorems relating to the continuity of the boundary values assignable to Dirichelet's problem. He extended the conception of the Schwarzian derivative to differential equations

of the third order, deriving the invariants and indicating the procedure to be adopted towards solution. In his crowned memoir, "Sui les équations différentielles du premier ordre" (1891), he propounded the theorem named after him that the points of indeterminateness, and in particular the essential singularities of the integral of an equation, are fixed points determined by the equation itself.

PAINLEVÉ'S Stockholm Lectures (1897), largely based on the theory of rational transformation of curves and surfaces, contain some of his best work treat of the analytical theory of differential equations and examine the descriptive properties of the in-Many of his later memoirs in the Comptes rendus deal directly with various problems in Function Theory—functions with unlimited essential singularities and expansions in series. As an extension of the theory of continuation he showed how to construct a single expression in the form of an infinite series of polynomials which would be a valid representation of a function over an extended domain. It is perhaps no exaggeration to say that much of the classical treatment of differential equations might never have been written were it not for Painlevé's investigations on that subject and on the theory of functions. In addition to his lecture at the Royal Institution on Nov. 15, M. Painlevé will speak at Cambridge on Nov. 16 on "Résistance d'un liquide au mouvement singulier d'un solide," and on Nov. 17 at the French Institute in London on "Absolu et Relativité." While at Cambridge, M. Pamlevé will receive the honorary degree of doctor of science.

Dr. A. W. Hill, Director of the Royal Botanic Gardens, Kew, sailed for Australia from Toulon on Nov. 4 on the invitation of the Commonwealth Council for Scientific and Industrial Research, Melbourne. Dr Hill expects to reach Fremantle on Nov. 29, and will visit the various botanical, agricultural, and forestry institutions in Western Australia, and will then proceed to Adelaide, Melbourne, Sydney, and Brisbane, to study the various botanical institutions in the different States, under the auspices of the Commonwealth Council. He also hopes to attend the meeting of the Australian Association for the Advancement of Science at Hobart in January next. Dr. Hill will then proceed to New Zealand on the invitation of the Dominion Government, where he hopes to spend some three weeks. He is going on to Java, where he will visit the Botanic Gardens at Buttenzorg on the invitation of the Director, and visits will also be paid to the Botanic Gardens, Singapore, Department of Agriculture, Kuala Lumpur, and the Royal Botanic Gardens, Peradeniya, Ceylon. Dr. Hill expects to return to Kew about April 20 next year. This visit is being undertaken as an outcome of the recent grant to Kew from the Empire Marketing Board, which was made to enable the Director or some senior member of the staff to visit different parts of the Empire to study botanical questions and matters relating to economic botany.

SIR CHARLES MARTIN, director of the Lister Institute, upon whom the honour of knighthood was recently conferred, has been presented with his portrait by the staff of the Institute as a token of personal esteem and appreciation of his great services during the twenty-four years of his directorship. Subscriptions to the portrait were confined to present staff and research workers and to past members of staff during Sir Charles's directorate. The painting of the portrait was entrusted to Mr. Neville Lewis, and the finished work has given much satisfaction The presentation of the portrait took place in the library of the Institute on Oct 28, when Prof. Harden presided over a large company of past and present members of staff and research workers. Prof. Harden referred in eloquent terms to the scientific and administrative ability of the director, his versatility and helpfulness, and above all to his great personal charm and tact which have conduced so greatly to that domestic harmony which has ever been the pride of the Lister Institute.

MEMBERS of the British Association have from time to time discussed the desirability of the Association's applying for a Royal Charter. It has been felt that the Association would be strengthened in its work for the advancement of science by the possession of a charter, but the cost involved has hitherto acted as a deterrent Mr A. A. Campbell Swinton has now generously offered to bear this cost, and the Council has resolved to recommend the General Committee to accept his offer and to authorise the president and general officers of the Association to apply for a charter on its behalf. The possession of a charter would, moreover, enable the Association readily to avail itself of a proposal made by Mr. George Buckston Browne, who, it will be remembered, offered to purchase Darwin's house at Downe for the nation, in response to the appeal made by Sir Arthur Keith in his presidential address at the Leeds meeting of the Association. Mr. Buckston Browne has now expressed his desire that the trusteeship of the estate should be vested in the Association, and the Council will recommend the General Committee to accept this further generous offer

THE preliminary notice of the proposed expedition to the Great Barrier Reef of Australia appeared in NATURE on Mar. 26 last. Circumstances have prevented the departure of the expedition this year, but the preparations have steadily progressed. At the meeting of the British Association at Leeds, a committee of Sections C, D, E, and K was appointed to organise the expedition for 1928. The second meeting of this committee was held at Australia House on Oct. 4, presided over by the chairman, the Right Hon. Sir Matthew Nathan, ex-Governor of Queensland, to whom the inception of the scheme is due. The aims of the expedition, which, it is hoped, will start in April next, are directly scientific, but it is anticipated that their realisation will throw light upon important economic problems. The leader will be Dr. C. M. Yonge, who will be accompanied by a staff including zoologists, botanists, a chemist, a surveyor, and, it is hoped, a geologist.

THE English committee will work in collaboration with the Great Barrier Reof Committee of Australia, the presiding genius of which is H. C. Richards, professor of geology in the University of Queensland, in carrying out the objects of the Expedition, which are "To examine a sector of the Great Barrier Reef from shore to ocean off Cairns, chart it accurately, surveying the associations of plants and animals on its surface, both qualitatively and quantitatively, study the food and power of lime formation in the same, and all such other matters as concern the formation and growth of that part of the reef." The secretaries are Prof. J Stanley Gardiner and Mr. F. A. Potts, of the University of Cambridge. A sum of £8000 is required, of which, with the aid of grants from the Australian Committee, the Royal Society, the British Association, and private subscriptions from members of Section D, a sum of £2250 has already been secured. It is hoped that, in view of the importance of this survey both scientifically and economically, further generous contributions will be made by scientific and commercial bodies, and particularly by private individuals. The treasurer, the Hon. John Huxham, Agent-General for Queensland, or the Secretaries will be glad to hear from persons who may be willing to make 'grants in aid.'

THE Institution of Civil Engineers was founded by half a dozen young engineers in 1818, but it was not incorporated by Royal Charter until 1828, Telford then being president. In view of the approaching centenary of its incorporation, Mr. E. F. C. Trench devoted a part of his presidential address, delivered on Nov. 1, to a historical review of inland transport problems Telford was famous for his roads, bridges, and canals, and in the revolutionary changes in the means of transport effected in the last hundred years, members of the Institution have taken a leading part The earliest roads of England, said Mr. Trench, were due to the Romans and were maintained by the State. Central control, however, vanished in the fifth century, not to return until more than a thousand years later. For centuries upkeep and repairs were unsatisfactory The first Turnpike Act of 1663 led to an improvement, and by the dawn of the railway era, some fifteen hundred stage coaches plied from London. The development of canals took place in the eighteenth century, and these for the first time provided easy and cheap transport for foods and minerals, resulting in a great incentive to industry, but the very success of the canals paved the way for a more flexible and quicker system.

Many railroads were sanctioned early in the nineteenth century, but the steam railway era set in with the Stockton and Darlington Railway of 1825 and the Liverpool and Manchester line of 1830. In the 'forties, hundreds of separate lines were projected, but Parliament was opposed to amalgamation. It is true a select committee of 1844, presided over by Mr. Gladstone, declared that "each new line should be viewed as a member of a great system of communication," yet Parliament in 1853 passed a resolution "that no railway Bill containing any powers of amalgamation, purchase, lease, working arrangement, or other combination of interest between different companies should be read a second time unless all such powers were struck out." The Railway Act of 1921 marked a complete change in the attitude of the Legislature Referring to the present position of the railways, Mi Trench showed what the companies have done to improve the services and yet effect economies. With the coming of the road motor vehicle, the virtual monopoly of the railways has come to an end. Railways, however, have spent £1,200,000,000 on land and tracks and expend £13,000,000 per annum in maintaining the tracks, while road vehicles found their track ready free of charge. Equity requires that the cost of the roads should fall on the road-users. In concluding his address, Mr. Trench said "that great and rapid as has been the advance achieved by the labours of the engineer . . . the true progress of civilisation depends equally upon corresponding developments in the less material fields of human thought and endeavour "

THE International Commission on the finds of alleged high antiquity at Glozel which was appointed by the Institut d'Anthropologie at the recent congress at Amsterdam is now at Vichy for the purpose of pursuing its investigations on the spot. Its arrival was preceded by that of Dr. Peyrony, who, as already announced, is in charge of the site under the Ministry of Education. The members of the Commission are M. Hanmal (Belgium), M. Pittard (Switzerland), S. Bosch-Guimpera (Spain), M Absalon (Czechoslovakia), Miss Garrod (Great Britain), and MM Ferrer, Peyrony, and Favrot (France). As all the members of the Commission are of proved competence in handling archeological evidence, their findings should inspire confidence both as to impartiality and accuracy. It is to be hoped that they will bring to an end a controversy which has at times been conspicuously free from the atmosphere of calm detachment which is supposed to be appropriate to the discussion of scientific problems.

ALTHOUGH the season's excavations have only just begun, the reports which have appeared in the Timesduring October of the work already carried out at Beisan by the Palestine Expedition of the University Museum of Philadelphia gives further promise of fulfilment of the great expectations from this site As exploration is extended in the lower levels of the eight strata identified, which cover a period of thirtythree centuries and date from the time of Amenophis III. to that of the Crusaders, the results become increasingly important to both the historian and the archæologist. Already this season two Canaanite temples, dated at 1500 B.C., have been discovered. They are the earliest yet known and throw an entirely new light upon early Canaanite religion. In one of the temples were two altars: one for cult objects, the other for sacrifice. An outer sacrificial altar exemplifies details of the methods employed in carrying out the ritual It has a channel to carry off the blood, a socket and peg for tethering the victim, and also a

socket for the pole on which the carcase was dressed. Near by were a sacrificial dagger, the shoulder blade of a bull, and a bronze pendant for suspension on the neck of the victim. On the level identified with the time of Rameses II. was found a door jamb, showing the figure of the builder of the temple of Dagon mentioned in Chronicles.

An earthquake was recorded at Kew Observatory on Nov. 4, commencing at 14 hours 3 minutes 14 seconds GMT. The distance of the epicentre is estimated to be 5540 miles. The New York correspondent of the *Times* states that earthquake shocks were felt along the coast of California on the morning of Nov 4, and that five miles of track belonging to the Southern Pacific Railway in Santa Barbara County were thrown out of alinement but no one was injured.

In his presidential address to the North-East Coast Institution of Engineers and Shipbuilders, delivered on Oct. 28, 1927, Mr. Maurice S. Gibb inquires into the probability of the British engineering industry being able to restore its prestige by lowering its costs of production sufficiently to enable it to retail its wares at attractive prices. He comes to the important conclusion that the industry is not so much in need of scientific investigation as of the ability to apply the scientific knowledge obtained. Valuable work is being done by the various research associations, but the real difficulty begins when the results obtained come to be applied to the everyday work of production in the office and shop. Referring to the factors which assist the industry in benefiting from the results of research, the teachers in technical colleges are commended, and the foundry metallurgist and works laboratory staff are valuable connecting links between science and production.

As examples of advances directly attributable to the proper application of scientific knowledge, Mr. Gibb referred to several improvements in materials and methods The production of special steels has made possible the modern aircraft and the higher cutting speeds of machine tools, and now the stainless variety opens up a new field of utility for iron and steel. Boiler plates, bronzes, and cast iron have also been considerably improved in quality. In regard to methods, the measurement of machine parts is now done much more scientifically and accurately; in mass production, the timing of the production of component parts is more exact; temperatures are accurately measured and recorded, the thermo-couple, by which temperatures at various places can be read at one centre, being now a practical instrument in constant use in engine and boiler rooms, in foundries and in other furnaces.

Another important aspect of the case is the economic effect of oil replacing coal as the principal fuel for power production. Coal is Great Britain's greatest material asset and contributes largely to increase our exports, so that it is in the national interest to develop the use of coal rather than oil. The engine builders and purchasers naturally take a narrow commercial view, and the latter demand and the former produce

the engine that will give the best financial return. However, taking a broader view, the cost of our engineering products will be increased as the coal industry diminishes, and it is therefore a matter of importance to the whole engineering industry. It is not suggested that the development of the internal combustion engine should cease, but rather that the problem should be approached from the opposite direction by further developing the steam engine. Whatever it may have already done, the coal industry itself is invited to assist in the work of investigating the possibilities of the coal-using engine, and this work, being of vital national importance, should receive attention before it is too late.

In his inaugural address to the Institute of Transport, delivered on Oct. 10, Mr. Roger T. Smith discussed the results already obtained on the Swiss Federal Railways (the C.F.F., Chemins de Fer Federaux). One of the reasons of the success of the electrification scheme of the C.F.F. is that an electric locomotive can provide about four times the increase in pull for the same drop in speed which the steam locomotive can give. This summer the average trailing load hauled on the C.F.F. by an electric locomotive was 100 tons greater than the average load hauled by a steam locomotive. At the same time, the average speed was increased by about 20 per cent. Unlike the steam locomotive, the electric locomotive can go up steep gradients with very little loss of speed. The saving of time over steam working in ordinary stopping passenger trams is considerably greater than for express trains owing to the high accelerating power of the electric locomotive. Owing to the special conditions in Switzerland, for example, the steep gradients and the many lengthy tunnels, electric traction has many advantages. Many international trains also run over the Swiss lines. It is difficult, therefore, to deduce from these results what the corresponding results in Britain would be. Mr. Roger Smith, however, has made careful estimates for main-line electrification schemes in Great Britain over long routes. He finds that the savings in working expenditure, as compared with steam, will pay on the cost of electrification from 5 per cent on fairly busy lines to as much as 12 per cent. in lines fully worked with dense mineral and goods traffic throughout the twenty-four hours.

ELECTRICITY was first introduced into mines as an obvious solution of the problem of driving in a confined space machinery for coal cutting, for haulage, and for working pumps. Safety of life is the dominant factor, and every modern development of underground gear is in this direction. In an article in the Electrical Times of Nov. 3, Prof. W. M. Thornton lays stress on the improved lighting of the underground roads and on the elimination of the horse as a means of traction. The oil lamp is useful as a gas detector in mines, but it will inevitably give place to portable electric lighting sets. Research has shown how much the comfort of the worker depends on the absence of a feeling of apprehension. There is reason for believing that this nervous feeling combined with bad lighting produces

that singular eye disease called nystagmus, the ineidence of which seems almost to be sporadic. The great electrical haulages found in many pits are the most active of all the means by which electricity saves the miner. The whole safety of underground workers, as in that of pedestrians in a busy town, depends on the probability of a set of dangerous factors occurring simultaneously. It is to reduce this probability that the Safety in Mines Research Board investigations are directed The spark occurring when an electric lighting circuit is broken may cause an explosion Prof. Thornton has shown that it is possible to go on breaking a 500-frequency 200-volt lighting circuit carrying 20 amperes in an inflammable mixture of coal gas and air for hours without anything happening. With 200 volts direct current, ignition followed at once when the current was 1 ampere. This suggests the possibility of using higher frequencies for lighting in mines. It has to be remembered, however, that by far the greatest number of accidents in mines is caused by falls of the roof and side. The only remedy is to erect with greater care and use improved mechanical means of support

At the ordinary scientific meeting of the Chemical Society on Thursday, Nov. 8, Sir Joseph J. Thomson was elected an honorary fellow of the Society.

WE much regret to announce the deaths of Dr. D. G. Hogarth, C.M G, Keeper of the Ashmolean Museum, Oxford, and president of the Royal Geographical Society, on Nov. 6, aged sixty-five years; and of Sir William Galloway, the distinguished mining engineer, on Nov. 2, aged eighty-seven years.

The annual general meeting of the Mineralogical Society was held on Nov. 1, and the following officers were elected —President, Dr. G. T. Phor., Vice-Presidents, Sir. John Flett, Sir. Thomas. Holland; Treasurer, Mr. F. N. Asheroft; General Secretary, Mr. W. Campbell Smith (Natural History Museum, S. Kensington, S.W.7); Foreign Secretary, Dr. J. W. Evans; Editor, Dr. L. J. Spencer.

THE British Mosquito Control Institute, Hayling Island, Hants, announces that arrangements have been made for short two- or three-day courses of instruction in mosquito control work to be given during the first week of each month. The first course will commence on Tuesday, Dec. 6, and will include (1) lectures dealing with the life-history, habits, and structure of mosquitoes, and various methods of control; (2) practical field work in the application of remedies; and (3) identification of mosquitoes in the laboratory. The instruction provided is intended primarily for those who wish to obtain an elementary knowledge of the subject in the shortest possible time. The two-day course is sufficient for this purpose, but those who wish to pursue their studies further will have an opportunity to do so on the third day. The Institute is also available for the use of research students, and is fully and admirably equipped for all these purposes. The courses will be of interest not only to persons going abroad, but also—and perhaps especially—to medical officers of health and others in Great Britain seeking information regarding the control of local mosquito pests. Full information can be obtained from the Director of the Institute.

A SPECIAL number of the Zeitschrift fur physikalische Chemie has been dedicated to Prof. Ernst Cohen, of the University of Utrecht, to commemorate the twenty-fifth year of his professorship.

Readers interested in South Africa should obtain catalogue No. 501 of Messrs. F. Edwards, Ltd., 83 High Street, Marylebone, W 1, which gives the titles, and, in many cases, other particulars of some 700 books, etc., relating to that part of the globe. A later catalogue, No 502, deals with nearly 900 works relating to the Near East and Egypt.

Prof. A. N Whitehead has a new book entitled "Symbolism: its Meaning and Effect," appearing through the Cambridge University Press. The same house will publish almost immediately "Psychology and the Soldier," by F. C. Bartlett. The work aims at showing how a knowledge of psychology and social psychology can be brought to bear upon the selection and training of recruits, the maintenance of discipline, and the development of morale. It also gives a brief account of some of the mental disorders of warfare and of their treatment.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned .—A special librarian at the Institute of Metals-G. Shaw Scott, Secretary, 13-14 Members Mansions, Victoria Street, S.W.1 (Nov. 15). A temporary draughtsman under the Directorate of Technical Development, Air Ministry —The Secretary, Air Ministry, Adastral House, Kingsway, W.C 2 (Nov. 18). A head of the department of mechanical and civil engineering at Loughborough College — The Principal, Loughborough College, Leicestershire (Nov. 21) A junior research officer in the Institute of Animal Pathology, Royal Veterinary College—The Director, Institute of Animal Pathology, Royal Vetermary College, Camden Town, NW.1 (Nov. 29) An assistant in the pathology department of the University of Aberdeen-The Secretary, The University, Aberdeen (Nov. 30). Two research assistants in the School of Tropical Medicine Laboratory, Freetown, Sierra Leone—The Hon. Dean, School of Tropical Medicine, Pembroke Place, Liverpool (Dec. 1) A telephone engineer under the Egyptian State Railways—Office of the Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1. A teacher of advanced engineering calculations at the Central Polytechnic, Croydon-The Principal An assistant at the Harper Adams Agricultural College, for special crop experiments— The Principal, Harper Adams Agricultural College, Newport, Salop

# Our Astronomical Column.

Shower of Large Meteors.—Mr. W. F. Denning writes that "on Oct. 31 an assistant watching the sky from his garden counted 51 meteors during the right. Of these, live were as bright as, or brighter than, Venus, and several others were equal to Jupiter The objects were not directed from one system but from several, the principal of which were as under:

 $\epsilon$  Arielids:  $42^{\circ} + 23^{\circ}$ .  $\alpha$  Arielids: 33 + 19. . . . 12 meteors. 8 meteors. 8 meteors. The bright meteors were nearly all conformable to one or other of these streams. The two in Aries have often been observed before, but the Andromedids have been very little in evidence at the end of October in past years. One of them, as bright as Venus, observed at 20h 32m GM.T. on Oct. 31, was also seen by Mr. Pye-Smith at Beckenham, Kent, as it passed through the central region of Perseus and disappeared a little to the left. The radiant point is indicated at  $27^{\circ} + 43^{\circ}$  and the height of the meteor 65 to 27 miles above the mouth of the Thames from north of Margate to east of Southwold The observer at Kent mentions that the light of the object illuminated his garden, and no doubt many metropolitan residents witnessed the flight of the meteor"

The Nebulosity around Nova Aquile III.—Shortly after the appearance of Nova Aquile III. (1918), Prof. Barnard discovered a bright nebulous envelope, about 0"7 m diameter, surrounding the star. Later observations by Barnard and Aitken showed that this envelope was gradually expanding and fading, until in 1921 it became too faint for visual observations. A series of photographs were taken in 1926 with the Mount Wilson 100-inch telescope, and the results are described by Hubble and Duncan in the Astrophysical Journal, vol. 66, p. 59. The photographs show the envelope as a

sharp circular disc, of about 16" diameter, with the star in a central position. The expansion therefore appears to have continued at a uniform rate of 1" 0 annually, which is in accordance with the early visual observations. Assuming a linear rate of expansion of 1700 km./sec. (based on radial velocity observations from early spectrograms), this would imply a parallax of 0" 0028, corresponding to a distance of 360 parsecs.

IDEAL LUNAR LANDSCAPES.—L'Astronomie for September contains an interesting article by M. Lucien Rudaux, contrasting lunar and terrestrial landscapes. The blackness of the sky and the absence of all aerial perspective, in addition to the great difference in the character of the surface features, increase the difficulty in making correct mental conceptions of the appearances that would be presented to an observer on the moon. The author gives a series of carefully designed pictures of various lunar landscapes. In one of these we are supposed to be standing at the bottom of a deep crevasse. One wall is brightly lit up by the sun; the other is faintly visible by reflection from it. The shadows must be far from black in regions where a large extent of sunlit cliff is in the field of vision Another picture shows the aspect of one of the smaller craters soon after sunrise; in another we are situated in the centre of the floor of Plato; only a few of the highest summits in the surrounding rampart are visible, the rest of it is below the horizon. There is also a picture supposed to be taken at the moment before sunrise. A portion of the corona and chromosphere have already risen, also the zodiacal light. A reconstruction is given of the isolated mountain Pico near Plato. It is much less precipitous than one is apt to imagine from its tapering shadow. In fact, its height appears to be only one-tenth of the diameter of its base. A series of careful drawings of this kind are a useful aid in forming correct notions of the nature of the lunar surface.

# Research Items.

THE DISTRIBUTION OF MAN-In Scientia for October, Prof. Mendes-Corrêa discusses the factors which must be taken into account in studying the question of the dispersion of early man over the earth. It must be remembered that early man, although man is the most widely distributed of the primates to-day, did not possess the mobility of modern man or his cosmopolitan character. His nomadism was restricted. The sea was a formidable obstacle, as it still is to-day to many coastal or insular peoples. In the earliest times geographical conditions canalised 'migrations and man was the slave of his environment, though gradually he came to react on it. Present ethnical distribution is no sure guide, and the continuity of occupation in any given area must be traced equally with the changes in an environment which may have modified its suitability for occupation. Further, in framing generalisations for large areas, local variations must not be overlooked, as for example in the clearings of equatorial Yet even so, forests and the oases of desert areas. geographical factors are not alone to be taken into account. Safety, the surroundings, adaptability for exploitation, social and political organisation, and the like must be considered. Turning to the place of origin of man, palæolithic man lived in Asia, as a number of discoveries show, the Siwalik Hills have produced fossil remains of early apes, a Neanderthal skull has been found in Palestine, and the peoples of to-day include a number of very primitive types. On the other hand, Africa has a palæolithic industry, remains of primitive types of early apes and man and the chimpanzee and Yet again all around the Indian Ocean and its archipelagoes are found localised groups of inferior types which require consideration. The negritoes of Malaya and the Australians may be early immigrants, and in addition there are Puhecanthropus from Java and Wadjak man. Discoveries in the Fayum, in the Siwalik Hills, and South Africa might point to a peripheral distribution of both anthropoids and Catarrhine apes of which the lemuroids of Madagascar might form part. The area of the Indian Ocean might thus appear to have been a centre of dispersion.

FIJIAN ROUND BARROWS.—In Man for October, Mr. A. M. Hocart corrects an inaccuracy in Williams's account of Fiji which has been brought to light by the use of a woodcut from that author's work as evidence of the existence of round barrows in Fiji. As a result of inquiry, Mr. Hocart has ascertained that Nautuutu. the barrow in question, was undoubtedly square. He has, however, now discovered among his own notes a record of a round barrow at Namoka on Vanua Levu which he had overlooked. He also observed a square mound at Nambuna and an oblong mound in Scanganga, so that three forms were found together. According to the native account, the temple was round, with one door and with pointed apex. It was built of the same materials as a house but ornamented. It was not built on the top of the mound, but the mound was inside it. This mound was the holy land on which no one might tread. In Ceylon there was, and still is, a custom of building a temple not on, but over the smaller topes. The author has already traced the tee of a Buddhist tope to a square shrine built on the tumulus. It is suggested that the house on the tumulus has petrified in a process of conventionalisation and its meaning been forgotten, and that another house has been erected on the whole. In Fiji this process has not taken place, and the house over the mound is not a reduplication but an alternative, which may have existed before the separation of the Indian and Fijian round barrows.

NORTHERN TINTINNIDS — Dr. E. Jorgonsen of Bergen gives an excellent account of the Tintimudæ in the North Sea and Baltic ("Die Tierwelt der Nord-und Ostsee," Lieferung 8, Teil II. c: Tintimidæ. Leipzig: Akademische Verlagsgesellschaft, 1927.) This group is little known except to plankton workers, and these know it better than any of the other Infusoria, as it contains the commonest and most easily recognisable plankton forms, both neutic and oceanic. A tintimid lives in a beautifully formed vase-shaped case or house, which remains intact after the death of the animal forming and inhabiting it. These cases are used as the basis of classification of the various genera, fitteen being recorded from this area; Tintinnopsis, the best-known genus, having ten species, the case being covered with extraneous particles such as sand grains and coccoliths. genera may have a perfectly smooth and hyaline case and some may be ringed spirally at the open end showing growth lines, others having regularly pierced cases like basket-work. The method of formation and structure of these cases is extremely complicated and difficult to elucidate. Inside the case the infusorian is fixed by a thread-like portion of the body, either at the bottom or the side: only very exceptionally is it loose. When actively swimming, the broad end, aimed with ciliated plates, projects from the case and, presumably, as it swims sweeps into the body small living creatures on which it feeds—flagellates, dinoflagellates, and diatoms. No worker knows the group better than Dr. Jorgensen, and the present survey is exceptionally welcome and useful to planktologists, as the Tintinnide in "Nordisches Plankton," the sister publication of "Die Tierwelt," has not yet appeared.

SEX-LIMITED HORNS IN CATTLE -From the experience of cattle breeders it has long been known that in the domestic breeds the polled or hornless condition usually behaves as a simple dominant to the horned condition. Exceptional cases are now being recorded, however, in which horns are a sex-limited character in crosses, being generally present in males and absent m females. Such cases are recorded by Mr. A. D. Buchanan Smith (Jour. of Genetics, vol. 18, No. 3) in crosses between native-horned cows in Rhodesia and Aberdeen-Angus polled bulls. The heifers produced were all polled, and the bulls nearly all had horns. Among the wild white park cattle of Britain there are horned and hornless herds, the Chillingham and Cadzow herds being horned, while several other herds are polled. Matings of horned with polled in these herds give an abnormally small number of polled calves, so that here also factors are present which modify the ordinary recessiveness of horns. Other records of a similar kind are cited, and the statement of Prof. Cossar Ewart is quoted, that several species of cattle with horned males and hornless females occur in the lower Phocene. This older condition appears to have persisted in some strains down to the present time. That such sex-limited inheritance may occur in a modern herd is indicated by a short record (Mr. O. O. Churchill, in Jour. of Heredity, vol. 18, No. 6) of a registered herd of Hereford cattle in North Dakota, in which matings between horned bulls and polled cows produced polled heifers and bull calves with horns or scurs. Future studies will throw light on the nature of the difference between

simple recessiveness and sex-linked inheritance of horns. That cattle were originally hornless is clear from the Phocene records of Leptobos species without horns. Mr. R. C. M. Auld (Jour. of Heredity, vol. 18, No. 7) gives a number of illustrations and records showing that the polled condition has persisted through historical time. Polled cattle existed in Egypt, 2150 B.C., they are shown on coins from Mytilene in the fifth century B.C and in prehistoric Pictish carvings in Scotland Palæolithic drawings of polled cattle, probably domesticated, are found in a French cave of the Madeleine period. The original hornless type thus gave rise to a horned race in which the horns were at first confined to the males. Horns are not considered an advantage in fighting between males, but their possession is useful in driving off carnivorous enemies. Whether they arose as a single mutation or in some other way, their origin would appear to have been a relatively sudden development.

TERTIARY MOLLUSCA OF JAPAN.—Reference has previously been made in these pages (NATURE, Sept. 11, 1926, p. 389, and Dec. 4, 1926, p. 819) to the important papers by Prof. Matajiro Yokoyama on the Tertiary Mollusca of Japan A further series of six papers by the same author has just arrived (Jour. Fac. Sri. Imm. Ilmw. Tokyo. sect. II., vol. 1). The Fac. Sci. Imp. Univ. Tokyo, sect. II., vol 1). The collections now dealt with come from the province of Tosa, in the Island of Shikoku or Nanka, and on the main ısland from the Atsumı peninsula and southern Tôtômı, the neighbourhood of Tokyo, and western Shimôsa and southern Musashi, as well as the oilfields of Akita in the province of Ugo. The same method is adopted as before in each paper: a brief but clear introduction discussing the topography and geology of the area in question, with a list of the geology of the area in question, with a list of the fossils, is followed by descriptions of the species and illustrative plates. In two cases useful indexes are appended. Taken together, these papers total 145 pages with 15 plates. With regard to the fauna of the Musashino beds (Pliocene) the author points out that it is more northern than that of the recent adjacent seas. A few of the species present are also found in the English Crags. There is inevitably a large number of new species.

THE ADELAIDE DISTRICT, SOUTH AUSTRALIA.-A paper read at the Royal Society of South Australia on Sept. 8, by Dr. C. Fenner, described the geographical development of the Adelaide district, South Australia. It was, in the Middle Kainozoic, a wide well-timbered plain of ancient rocks, with meandering streams, broad swamps, and a warm temperate climate. This plain sank below sea-level, and the submergence lasted throughout the Miocene and part of the Pliocene, after which it was slowly uplifted as a low-level limestone plain. About the beginning of the Pleistocene were formed two great semi-circular sunklands bounded to the east by the Mount Lofty and Flinders Ranges The lowest parts of the sunklands were occupied by Lake Torrens and the Spencer-Vincent Gulfs. The Mount Lofty Highlands were covered with Miocene limestone; but this cover has been mainly stripped off by river action, which also carved out deep valleys and covered the lowlands with alluvial material. The gorge of the Torrens River is attributed to the Pleistocene, and the upper valleys to possibly the late Phocene. The country was colonised about a century ago, but its development was hampered by the mountain barrier between the Adelaide plains and the Murray Valley. The rate of growth of progress of the population has recently been greatly accelerated, and if the present rate continues until 1940 the population would amount to 450,000. By 90 years growth it has reached

320,000. Adelaide is now the chief market and port of the State of South Australia, and is a rich garden owing to the conjunction of favourable climatic conditions, city site, and general amenities.

Mountains of North-Eastern Siberia.—During last year a series of important geographical discoveries were made by S. V. Obruchev during the course of his exploration of the little-known region traversed by the Indigirka and Kolyma Rivers. A very considerable mountain system was found trending across the upper Indigirka, reaching heights of 3000-3300 metres in places A preliminary report appears in the Zeitschrift fur Gletscherkunde of July, 1927. Although no glaciers were seen, the mountains were found to be capped with perpetual snow, and the landscapes and surface deposits clearly indicated very extensive glaciation in the past. Mountain ranges to the east and west have already been mapped, and altogether a system 1000 km. in length and roughly 300 km. across is now known, forming an arc concentric with the previously known outer arc of Verkhoyansk-Anadyrsk. From the point of view of Asiatic tectonics and the former glaciation of Siberia, Obruchev's work is of fundamental value, and further details will be eagerly awaited.

THE GEOLOGY OF THE SPRINGBOK FLATS.—A memoir of more than usual interest on the northeastern part of the Springbok Flats has just been published by the Geological Survey of South Africa (Explanation of Sheet 17, 1927, by Dr. Percy A. Wagner). Points of particular importance are the descriptions of the Rooiberg beds (Transvaal system) and their associated keratophyres and nodular felsites; the marble formations of the Dolomite series; the igneous rocks of the Bushveld complex; the local development of the Karoo system and the Stormberg volcanics; and the general physiography of the 'Flats'. Interesting evidence of climatic changes is presented. There is clear proof of an epoch of (a) vigorous erosion succeeded by (b) an and period which led to the aggradation of the valleys with silt; and finally (c) renewed vigorous erosion in which the present streams have cut down to the coarse gravel or bedrock with which the valleys are floored. The rejuvenation is not due to a steepening of grade, but to an increase of rainfall; and Roger's contention that there is no ground for the common opinion that South Africa is drying up thus receives strong support.

MAGNETIC OBSERVATIONS IN THE NORTH.—The Danish Meteorological Institute has initiated a new series of occasional publications (in octavo form) entitled Communications Magnétiques. The first two issues, lately published, contain five interesting papers, of which the most noteworthy is perhaps that written by the Director, Dr. La Cour, "on the mean error of the monthly means of the magnetic elements observed at the observatory of Rude Shov." This able and valuable paper consists of a comparison of the apparent changes in the monthly means obtained at eleven European observatories during 1911-1920, and throws light on the probable freedom (or otherwise) from small systematic errors in the absolute magnetic observations at these stations. Another paper describes the novel and apparently satisfactory method of direct determination of scale values for the magnetographs of the recently instituted Danish observatory at Godhavn. Greenland; the daily variations of the elements are so great that the scale values can be measured by taking absolute observations at different times of the day. The other three papers deal with the heating of the upper atmosphere by eathodic rays (connected with auroræ) from the sun; and with the values of the magnetic elements at Rude Skov during the recent eclipse, and during a still more recent magnetic storm -of July 22, 1927.

Tidal Research.—The eighth annual report of the Tidal Institute of the University of Liverpool indicates a steady growth in the work of tidal analysis and prediction executed by the Institute for the Admiralty and various port and harbour boards in Great Britain, and for the Hydrographic Offices of Canada and China—The methods of computation have been further improved and simplified. Various improvements have also been made in the tide-predicting machine of the Institute; one of these, the fitting of ball-bearings for the pulleys, has reduced the friction and practically eliminated the small elastic variations in the length of the tape which had been found due to friction at the pulleybearings. The director, Prof. Proudman, and the secretary, Dr. Doodson, have continued their studies on the dynamical theory of tides.

X-RAY TUBE RADIATION.—In the issue of the Physikalische Zeitschrift for Sept. 15, Drs. D. Nasledow and P. Scharawsky, of the Rontgen Institute, Kiev, sum up their conclusions as to the variation of the intensities of the characteristic lines and of the whole radiation from X-ray tubes with the current through the tube. The intensity of radiation is measured by the current transmitted through a tube containing air ionised by the radiation under the action of a constant electromotive force sufficient to produce the saturation current. Anticathodes of copper, molybdenum, palladium, silver, and tungsten have been investigated, and all give for currents of a few milliamperes through the tube, intensities of radiation proportional to the current, up to a critical value which increases with the atomic weight of the metal from 4 to 8 milliamperes, after which the increase of the intensity is proportional to the increase of the current. The change of slope of the intensity-current graph at the critical point increases as the electromotive force on the tube increases.

THE ELECTRONIC STRUCTURE OF ATOMS AND THE Periodic Classification.—The relation between atomic structure and the periodic classification is discussed in a preliminary paper by J. D. Smith Main in the Journal of the Chemical Society for September. A classification is put forward which facilitates the interpretation of atomic structures without suppressing the chemical importance of the usual eight valency groups. Instead of expanding the groups in the periodic table, as has usually been done when the mathematical interpretation of atomic structure has been the chief interest, the author considers that the chemical properties are best brought out by its abridg-This involves the relegation of a considerable number of elements in the long periods to the position of 'transitional elements.' Elements in the abridged periods are regarded as having valencies which vary only in multiples of two, difficult exceptions being otherwise explained. Eight groups are thus found, divided into an 'alkaline' group, an 'amphoteric' group, and a 'non-basic' group, the valencies running in units from I to 7 and then falling to zero, or else, in each group, differing by 2, 4, or 6. Two extra tables of transitional elements are then received. of transitional elements are then required, one contaming the rare earth elements. The complete table is then formed by combining these sets of elements. This complete table differs only slightly from the usual table in appearance, but the so-called 'transitional' elements are now distributed in the body of the table

as well as occurring in Group VIII. The rare earth elements must form a 'footnote' to the table

CO-ORDINATION COMPOUNDS OF QUINQUEVALENT MOLYBDENUM.—The September issue of the Journal of the Chemical Society contains an account of a study of salts of the types R<sub>2</sub>[MoOCl<sub>5</sub>], R|MoOCl<sub>4</sub>, H<sub>2</sub>O] and [MoO<sub>2</sub>X<sub>2</sub>, 2H<sub>2</sub>O]R. One of the most interesting features of certain of these salts is the large number of ions produced when they are dissolved in water, the various stages of ionisation being accompanied by distinct colour changes. At infinite dilution, the complex salts R<sub>2</sub>[MoOCl<sub>5</sub>] yield ten ions and consequently have very high molecular conductivities. Several new salts have been prepared.

GRAIN GROWTH IN COMPRESSED TUNGSTEN POWDER. -The only systematic examination hitherto on this subject is that due to Sauerwald, who considered that grain growth occurred at the same temperature of 2500°-2700° C. irrespective of the method of preparation of the powder or the pressure. Smithells, Pitkin, and Avery, in a paper presented at the September meeting at Derby of the Institute of Metals, have re-examined the subject. From determinations of the electrical energy required to heat the powder, the density and the microscopic condition of the product, they have shown that the temperature of sintering is a function both of grain size and of the pressure used in forming the bar. Using powders the mean particle size of which varied from  $0.6\,\mu$  to  $35\mu$  and pressures from 8 to 32 tons per sq. m, the temperature at which grain growth could first be detected varied from 1100° to 1500° K. The finer the powder and the greater the pressure the lower was the temperature necessary for growth. It is known that if the hydrogen atmosphere in which the tungsten is heated contains even a trace of moisture, the structures obtained are greatly affected. In this work the greatest care was used in drying the gas, but the oxide originally present in the powder may have influenced the changes observed.

THE SOLUBILITY OF CEMENTITE IN a-IRON - The extent to which carbon is soluble in a-iron, though admittedly it cannot be large, has not yet been satisfactorily settled. A paper by J. H. Whiteley to the recent Glasgow meeting of the Iron and Steel Institute carries the matter somewhat further and shows that there is a marked merease in this solubility as the temperature is raised, and at 720° C. the solubility is about 0 03 per cent. At 630° C. it is still appreciable and the carbide may be retained in solution in the iron by rapid cooling. The quenched material on tempering precipitates carbide at or below 250° C., and as the temperature of tempering is raised the minute globules thus formed travel to the crystal boundaries. The velocity of this migration increases with temperature, and at 550° C. is very great. By quenching below the Acl point, sufficient carbide is retained in solution by the iron as compared with that in a slowly cooled sample appreciably to increase the Brinell hardness. During slow cooling the carbide is thrown out of solution on the existing particles and the inference is drawn that slowly cooled ferrite in ordinary steels contains little if any carbon in solid solution. This is in accord with the conclusions of Yamada and Yensen, who place the solubility limit at less than 0 01 per cent. As the purity of the iron is reduced by the presence of other elements in solid solution, the solubility of carbide in the a-ferrite is in all probability correspondingly reduced and the temperature at which the solubility commences to increase rapidly is somewhat raised.

# Draft Statutes for the University of London.

WE published on July 10, 1926, a leading article on the reconstitution of the University of London The position at that time was that the Government had redeemed its pledge to introduce legislation "to make further provision for the University of London" by introducing a Bill in the House of Lords, and this Bill had been accorded its second reading on the motion of the Earl of Balfour Nov. 19, the Bill received its second reading in the House of Commons on the motion of Lord Eustace Percy, president of the Board of Education, in a conciliatory and closely-reasoned speech. Dr. Graham Little, the member for the University, led the opposition in a vigorous speech, urging that any necessary changes in the constitution of the University should be made by those having internal knowledge of its work and aspirations. "It is in the interests of freedom," he said in his peroration, "the freedom of the University and the freedom of the students, especially of external students, that I beg the House to reject the Bill." Capt. Fairfax, who seconded the rejection, was supported by Sir Richard Barnett; but most of the speakers, including Mr. Trevelyan, Mr Withers, Sir Alfred Hopkinson, Mr Lees Smith, Mr Hilton Young, accepted the main principles of the Bill, which passed its second reading without a division. The proceedings in Standing Committee on Dec. 2 produced two important Government amendments, the first safeguarding the interests of theo-logical colleges whose position is differentiated from that of other colleges in their not receiving financial support from the Government; and the second, in the form of new clause—a concession implementing the Government's declaration that there was no desire or intention to establish State control of the Universityauthorising recommendations to His Majesty Council from persons or bodies representative of the University regarding the appointment of the crown members of the council of the University. received the Royal Assent on Dec. 15, and its short title is "University of London Act, 1926."

The chief purpose of the Act, in accord with precedents recently adopted for Oxford and Cambridge, and followed also for London in the earlier re-constitution under the Act of 1898, is to appoint commissioners to draft new statutes for the University. Mr. Justice Tomlin is chairman, and the other commissioners are Sir Amherst Selby-Bigge, Sir Cyril Cobb, Sir Josiah Stamp, Sir Cooper Perry, Dr. A. D. Lindsay, Miss Bertha Phillpotts, and Prof T. P. Nunn. Sir Henry Sharp has been appointed secretary. The duty of the commissioners is to make statutes for the University "in general accordance with the recommendations" of the Departmental Committee of the Board of Education, appointed by Mr. Trevelyan in 1924 "subject to any modifications which may appear to them to be expedient." The first draft of the proposed statutes has been published by the commissioners, who invite representations thereon pursuant of sub-section (2) of section 4 of the Act.

suant of sub-section (2) of section 4 of the Act.

Under section 21 of the draft statutes, a "Council of the University" is to be appointed of 16 members with power "to determine finally any question of finance arising out of the administration of the University or the execution of its policy, or in the execution of any trust requiring execution by the University." Its members are the chancellor, vice-chancellor, and chairman of convocation ex officio, six members of the senate appointed by the senate, four by His Majesty in Council, two by the London County Council, and one co-opted member.

Under clause 39, the senate is to consist of 50 (or possibly 51) members, namely, the chancellor, the vice-chancellor, the chairman of convocation, and the principal ex officio, 16 by convocation to be elected by the graduates according to faculties, 16 by the faculties composed of teachers of the University, 11 by colleges and medical schools, and 4 co-opted members. The colleges which are to be granted direct representation are: University, King's, Bedford, Birkbeck, East London, Imperial, London School of Economics, Royal Holloway, and Westfield (the last two have been added to the list published in the report of the Departmental Committee), and two representatives of the general medical schools to be elected by a meeting of the deans of such schools. The senate is to be "the supreme governing and executive body of the University in all academic matters." The vice-chancellor need not an electron be a member of the senate, and if he is not, the total membership of the senate will be increased to 51.

There are to be five standing committees of the senate, namely, the academic board, the board for external students, the collegiate board, the university extension and tutorial classes board, the matricula-The academic tion and schools examination board. board is to include, in addition to the 16 faculty members of the senate, 9 other persons appointed by the senate. The principal is to be chairman of the collegiate board, to be composed of college principals and to be responsible largely for the co-ordination of the teaching work of the University. No important change has been introduced into the organisation of faculties and boards of studies, but the regulations governing the admission of schools to the University are to be made more stringent. New schools, other than theological colleges, will be prohibited from applying for or receiving any money from any public body otherwise than through the council of the University, and will not be allowed, except with the consent of the council, to appeal publicly for money or accept any benefaction to which any onerous condition is attached

Under the existing statutes based on the Act of 1898 the senate is "the supreme governing and executive body of the University." Apart from the powers to be assigned under the new statutes to the council, the senate under the new statutes (Draft Statute 48) "may delegate or authorise the delegation of any of their powers to any standing committee of the senate or to any subordinate committee or body."

The appointed area for the admission of new schools is the administrative County of London, including the County of the City of London. But teachers of the University may be recognised in institutions situated in this area or in Middlesex, Surrey, Kent, Sussex, Essex, or Hertfordshire. Also the senate may admit as a school of the University any public educational institution situate outside the County of London which is wholly or mainly devoted to the pursuit of some branch of University study, which cannot, in the opinion of the senate, be adequately pursued in any institution within the London area or for which no recognised teacher or adequate body of recognised teachers is available in the larger area for such recognition (Draft Statute 106).

Under clause 134, a new power is to be given to the senate to "revoke any degree, diploma, certificate, or distinction conferred by the University, and all privileges connected therewith, if the holder shall have been convicted in a court of law of felony or of

any misdemeanour which, in the opinion of the senate, by reason of its immoral, scandalous, or disgraceful nature, renders him unfit to hold any such degree, diploma, certificate, or distinction"; and on good cause shown to restore the same degree, diploma, certificate, or distinction, without further examination.

Special college examinations, both at the intermediate and final stages, are authorised by draft statute 137.

A list of schools of the University "immediately prior to the appointed day" is printed as a schedule. The office of the commissioners is 5 Clement's Inn, W.C.2.

# The Gibraltar Skull.

A Ta meeting of the Royal Anthropological Institute held on Tuesday, Nov. I, Mr. H. J. E. Peake, president, in the chair, Miss Dorothy Garrod described the excavations at the Devil's Tower, Gibialtar, in which she had discovered the skull now known to be a relic of Neanderthial man. Mr. L. H. Dudley Buxton gave a description of the skull, and Prof. G. Elliot Smith described the endocramal cast, from which it has been possible to observe the main features of the conformation of the biam.

Miss Garrod gave an account of the excavations in the spring of 1926 in the cave, which was first observed by the Abbé Breuil during the War when excavation was impossible. The portion of the skull first discovered was found embedded in hard travertine, from which it was blasted with dynamite The fragments were near one another but not contiguous. In the autumn, excavations were resumed, and the cave and talus were cleared down to bed rock, where further fragments of the skull, including part of the lower mandible, were discovered The associated remains of fauna indicated that the skull was of Pleistocene age. The differences in the species represented here and those from other sites of the same period are attri-They are characteristic buted to the warmer climate of the Spanish Pleistocene age. All the implements discovered in the different strata were of Upper Mousterian type. The cave had apparently been used as a place of habitation, but probably only at cortain seasons of the year.

Mr. Buxton said the human remains discovered by Miss Garrod in her excavations include the following bones of a human skull: the frontal, the left parietal, the right half of the maxilla, the right temporal, the greater part of the lower mandible, and four milk teeth, two molars being still in their places in the upper and lower jaws respectively, unfortunately not on the same side.

Although there are certain gaps which make reconstruction a matter of considerable difficulty, there is no reasonable doubt that the bones belong to the same individual, as many of the pieces fit together, and those which do not, that is, the temporal and the parietal, can be shown to belong to the same skull by duplicating the bones, so that a left temporal is made to fill up the gap on one side and a right parietal the gap on the other.

Apart from other details, the age is best indicated by the teeth. The first permanent molars were never erupted, but were nearly ready to erupt. It is therefore reasonable to put the age at between the fifth and sixth years, as the permanent molars erupt in the latter year. This is merely an indication, as we have no evidence that the teeth of Neanderthal man erupted exactly at the same time as those of modern man. It seems probable from the size and general characters that the sex was male, and that the La Quina child was therefore female.

Although, no doubt owing to the age of the specimen, the brow ridges have not yet attained that development which is so marked a feature in Neanderthal man, the remains certainly belong to a member of that branch of the human family. Apart from details the most striking characters are the low flattened

form of the vault and the form of the massive jaw. The teeth when viewed by X-rays show the 'taurodont' appearance, both in the decidious and uncrupted permanent teeth, which is not the least of the characteristic features of Neanderthal man.

Prof. Elliot Smith said Miss Garrod has made it clear that the fossilised skull fragments found by her can be referred with certainty to the Upper Mousterian phase of culture, and Mr Dudley Buxton has shown that they formed a part of a five-year-old child who conformed to the Neanderthal type. Hence it is a matter of some interest to discover in the endocranial cast features that sharply differentiate it from those of all other known representatives of the Neanderthal species. There is a fullness of the prefrontal and parietal areas such as is unknown except in *Homo sapiens*. Yet the general form of the cast conforms to the Neanderthal type.

The question naturally arises whether this apparently exceptional development of the brain may not be due to some pathological condition, such as hydrocephalus, causing a general expansion of the cerebral hemispheres. While the possibility of hydrocephalus cannot be wholly excluded, there are reasons for regarding such an explanation of the condition as improbable. The excavations upon the inner table of the cranium that correspond to the convolutions are exceptionally distinct for a young child's skull, and the ridges that separate them are too salient to be reconciled with an hypothesis of hydrocephalus.

Hence it appears that the unexpected form can be accepted as definite evidence of an altogether exceptional development of the prefrontal and parietal areas for a member of the Neanderthal species. In Neanderthal man the most obtrusive feature of the endocranial east, as Anthony and Boule have emphasised, is the small size of the prefrontal area. But the series of Neanderthal crania that are now available for study reveal a considerable range of variation in the size of the frontal territory. Admitting that the Devil's Tower skull differs from the rest in an exceptional expansion of those areas of the brain which confer upon Homo saprens his most distinctive attribute, it must not be assumed that the Gibraltar child represents a link between the two species. It is definitely Neanderthaloid and must have acquired its peculiar cerebral characters independently of Homo sapiens by convergent development. Nor must the condition be regarded as a normal precocity of the Neanderthal child that afterwards atrophies. child's skull found at La Quina in 1921 by Dr. Henri Martin conforms in every respect to the adult Nean-Particular emphasis is laid in Dr. derthal type. Martin's and Prof. Anthony's reports upon the defective development of the frontal region.

The peculiar form of the Devil's Tower skull is, however, influenced to some extent by the age of the child, for it presents a certain analogy to the peculiarities often found in the five-year-old child of *Homo sapiens*. The chief interest of the endocranial cast of the Devil's Tower skull is the demonstration it affords that Neanderthal man reveals indications of possibilities in cerebral development formerly supposed to be the exclusive privilege of *Homo sapiens*.

# Structure and Formation of Colloidal Particles.

THE joint discussion between the Sections of Physics and Chemistry held on Sept. 2 at the meeting of the British Association at Leeds on the subject of the structure of colloidal particles, directed attention to the remarkable progress which has been made in recent years in the elucidation of the texture of disperse systems.

Both Sir William Bragg, who presided, and also Dr Freundlich laid emphasis on the importance of the method of examination by means of X-rays as well as on the limitations of the method. If the particles of a colloid are crystalline but not orientated in any specific direction, such as in gold and silver sols dispersed in water, a characteristic line photograph is obtained, whilst in addition, if the particles are orientated round an axis, as is the case in certain fibres, a spot pattern photograph is obtained. In many cases it is found that the broad diffuse rings indicating an amorphous character are replaced by the line photograph of the crystalline material as the suspension grows older, and we thus obtain a convenient method for determining the velocity of crystallisation of these substances.

When X-ray photographs are taken of liquids, it is found that in certain liquids, for example, cyclohexane, the rings are much more distinct and sharply bounded than in others; similarly, in the photographs taken of iron, prepared for the synthesis of ammonia by the catalytic method, both broad and thin rings can be obtained dependent on the method of preparation and the period of sintering. It is clear that we are dealing with materials which have a tendency to orientate themselves to form crystal nuclei.

It is somewhat unfortunate that the measurement of the breadth and intensity of the lines alone does not allow us to distinguish between two effects, whether the change in line breadth and intensity is associated with a change in the size of the nucro-crystals or a growth in the number of orientated particles. At the present time a method of distinguishing between these two factors is a matter of some importance.

Whilst the X-ray method alone gives no definite clue to the shape of the particle, it does at least give some indication of the processes by which crystals grow more readily in certain directions than in others, thus, the lamellar or flake-like character of large crystals of the fatty acids is readily anticipated from the crystal form determined by this method. Since, however, the shape of the particles is defined by magnitudes although submicroscopic yet greater than molecular in size, we may obtain information on this point by optical methods. A distinction between spherical and non-spherical particles can readily be made by observance of the scintillations in the ultra microscope or the double refraction of light in sols streaming through a channel, and even by the light absorption of colloidal solutions; thus, many sols, such as arsenious trisulphide and non-stretched gelatine, are found to be spherical.

The optical behaviour of streaming sols in a Tyndall beam gives some indication of the shape of the particles when these are not spherical; thus, it is possible to distinguish between attenuated string or rod-like particles in contrast to those plate-like or lamellar in form. The optical evidence for the rod-like structure of the colloidal particles of sols such as benzopurpurin or vanadium pentoxide is again supported by the shape of the macro crystals of these materials grown in the ordinary way. It is, indeed,

stated in the literature that benzopurpurin crystals can be grown so long and slender that they will pass through the pores in a filter paper in their end-on position, and that the crystals themselves are in continuous flexion under the influence of the Brownian agitation.

It is somewhat remarkable that the crystals of silver sols, which from their crystal growth one might reasonably anticipate to be either octahedral or possibly cubic in form, actually appear to deviate from the regular structure towards a lamellar form.

Such optical methods provide weapons with which the problem of the mechanism of formation of colloidal particles can be attacked. Von Weimarn's well-known criterion of the magnitude of the dispersion coefficient permits the prediction of the form of an insoluble product formed by interaction of two soluble salts. In cases where the dispersion coefficient is high, colloidal solutions or even gels may be obtained: the individual particle size is partly determined by the dispersion coefficient and the growth rate may be termed, with Haber, the grouping velocity. The clusters or aggregates of molecules thus formed at haphazard must, in order to become a crystalline assemblage, become orientated in their space lattices. This action may proceed at various rates; the velocity of orientation may be, and frequently is, very different from the grouping velocity.

It is thus possible to prepare numerous colloids, both in the crystalline as well as the amorphous state, by suitable adjustment of these two velocities. By rapid condensation of silver vapour admixed with naphthalene at liquid air temperature, for example, the preparation of colloidal amorphous silver can be effected, whilst under the ordinary conditions for preparing both colloidal silver or gold, the particles are completely crystalline, an indication that the velocity of orientation is extremely high.

These changes from the amorphous to the crystalline in solid substances can thus take place at different rates and are at least to a certain extent under control; that mechanical effects, such as stretching or pressure, effect orientation of the cell units in substances as varied as rubber, gelatine, and waxes, is definitely revealed by X-ray examination. An equally complex but interesting field for study is the structure of aerosols or smokes. As was pointed out by Prof. Whytlaw-Gray, the study of smokes is rendered more difficult by the fact that smokes are unstable and continue to undergo processes of aggregation and precipitation. Nevertheless, from photomicrographs it is possible to recognise definite crystal structure in many of such aggregates: in others the smoke particles appear as small spheres. It is at present a matter of interesting speculation whether the conceptions of von Weimarn and Haber on the conditions of formation of particles in solutions are not applicable in this field also

It is frequently argued that problems such as the shape or form of colloid particles may be a matter of deep scientific interest, but that the industrial chemist is satisfied provided that his suspension or smoke fulfils certain standard arbitrary tests, for example, grain size. A brief consideration of the relatively great covering powers of plate-like particles in paints and glazes, or the factors governing the adhesion of fungicides, to mention but two cases, shows that the discussion held at Leeds was full of import to numerous industries.

ERIC K. RIDEAL.

# University and Educational Intelligence.

CAMBRIDGE.- -Prof. A. S. Eddington has been elected as a member of the Council of the Senate. Mr. F. H. Garner has been appointed University

demonstrator in agriculture.

The annual report of the Board of Research Studies makes interesting reading. There have been 72 degrees of Ph.D. awarded during the year, 5 of M.Sc., and 6 of M.Litt. A third of the 272 resident research students are now graduates of Cambridge; the other English universities send 37 research students, the United States 31, Scotland 21, Australia 17, Wales 16, Canada 12, and South Africa 10. As to subjects, chemistry has 42 students, physics 35, mathematics 25, English 21, history 20, while divinity, geography, fine arts, metallurgy, and moral science claim but one student each. Trinity has now a strong lead in the number of research students with 46, followed by Emmanuel, 37; Caius, 25; and Newnham, 21; at the other end of the list are Peterhouse, 3; Pembroke, 2; Jesus, 2; and Selwyn, 3.

MANCHESTER.—Mr. T. H. Osgood has been appointed an assistant lecturer in physics.

The Council has appointed Prof. A. H. Gibson to represent the University at the celebration of the centenary of the Institution of Civil Engineers.

The following awards have been made: Grisedale biological scholarship in botany to Frances L. Stephens; William Kirtley senior scholarship in engineering to Frank Roberts.

THE degree of doctor honoris causa of the University of Paris has been conferred on Sir Frederic Kenyon, Director of the British Museum, and Prof. J. S. E Townsend, Wykoham professor of physics in the University of Oxford

THE third annual report, for 1926-27, of the London School of Hygiene and Tropical Medicine, was presented to the Court of Governors, which met on Oct 31. The Director, Dr. Andrew Balfour, reported on the work of the Tropical Division, and stated that the advantages of the twenty weeks' course of study in tropical medicine and hygiene, as compared with the shorter course, have now been definitely established. A Division of Medical Zoology has been constituted for administrative purposes, comprising the three Departments of Entomology, Helminthology, and Protozoology, with Prof. R. T. Leiper as its head. The organisation of the Museum continues to make steady progress under the immediate direction of Major-General Sır Wilfred Beveridge. Prof. W. W. C. Topley has been appointed to the chair of bacteriology and immunology, and is conducting a course of instruction for the newly instituted Diploma in Bacteriology of the University of London. The construction of the new building for the School, delayed by the coal dispute of last year, is now making substantial progress The provision of clinical and pathological facilities for the study of tropical diseases has been considered by a committee, which recommends the establishment, adjacent to the School, of a hospital with 150 beds, for which a capital sum of £250,000 would be The financial account for the year shows necessarv. an unexpended balance of £1452. The Trustees of the Rockefeller Foundation have now transmitted the whole amount of their original gift of two million dollars, which has been converted into sterling at a favourable rate. The University Grants Committee has notified that the grant of £7200 for 1926-27 has been increased, with the consent of the Treasury, to £18,000 for the new year.

An address on the future of technical education was delivered by the President of the Board of Education on Oct 19 at the Wigan Mining and Technical College. Two points were specially emphasised · the importance of guidance in the shape of specifications deliberately formulated by industrialists of what kinds of skill they wish to find in the recruits they are to draw from the technical schools, and the importance of mcreasing the day classes, which at present have very few pupils compared with the evening classes. As regards the first point, such specifications should provide for technical education the same kind of help as the secondary schools and universities receive, and have, for generations past, received from the pro-fessions. Much attention has been given to this matter during the past two years in the United States, where more than six hundred 'job specifications were drawn up a year ago by twenty-five of the largest industrial concerns in the country. Lord Eustace Percy hopes that with increasing definiteness of aim, technical education will be susceptible of more effective advertisement than is possible at present and will, in consequence, obtain more support. He attaches much importance to this task of "making a more or less clear picture out of the kaleidoscope of technical education." Referring to the need of more day classes, he pointed out that whereas about ninety per cent. of all our technical education is conducted in evening classes, about eighty per cent. in Prussia is in classes which do not meet after eight o'clock in the evening In Germany likewise, employers of labour commonly make attendance by their employees at day classes obligatory.

In the course of a recent discussion of "Technical and Non-technical Management" by the British Section of the Société des Ingénieurs Civils de France, an interesting account of technical education in France was contributed by Mr. Androuin and the reader of the paper, Mr. Lucien A. Legros. It would appear that a great deal of attention is being devoted to the improvement of apprenticeship. Certain works, such as those of Panhard and Levassor, make special arrangements for the training of their apprentices, for which purpose the older employees are engaged in providing an intensive training in pattern making, machining, and fitting. The value of the instruction is increased since the work performed is on parts which are actually required in the factory in small quantities. Technical instruction in France is given in public, national, and municipal schools. Private schools work in association with, or model themselves on, the State schools, and if efficient they are assisted by the Ministerial Department of Technical Education, which is said to be one of the best managed of State institutions. In all the schools the aim is to provide a thorough groundwork, on which specialised training can afterwards be developed. The Polytechnic, the Schools of Mines, of Bridges and Highways, of Posts and Telegraphs, etc., are very well known and have been founded to supply engineers for the Government services. In addition, there are numerous important technical colleges and specialised schools. In all the industrial schools a certain amount of commercial training is prescribed, while industrial technology is taught in the commercial colleges. In the Écoles des Arts et Métiers, instruction is given in both theory and practice. Third-year students are sometimes made charge-hands over small groups of other students, and this has proved so successful that steps are being taken to extend the practice. Students are also instructed in the making of drawings, and in estimating and preparing cost cards for various parts ordered by manufacturers.

# Calendar of Discovery and Invention.

November 13, 1807.—The mangural meeting of the Geological Society was held at the Freemasons' Tavem, Great Queen Street, on Nov 13, 1807. Among the eleven gentlemen present were Davy, Babington, Count Bournon, Greenough, William Allen, and Richard Phillips At this meeting a resolution was passed "That there be forthwith instituted a Geological Society, for the purpose of making geologists acquainted with each other, of stimulating their zeal, of inducing them to adopt one nomenclature, of facilitating the communication of new facts, and of ascertaining what is known of their science, and what remains to be discovered."

November 14, 1894.—Ten years after Sir Charles Parsons patented his steam turbine, the pioneer steam turbine vessel *Turbinia* was constructed on the Tyne, and on Nov. 14, 1894, carried out her preliminary trial. The *Turbinia* was 100 feet long and 441 tons displacement. Her first engine was a single radial flow turbine giving 960 h.p. at 2400 r.p.m., but this was afterwards replaced by three turbines developing 2000 h.p. and giving the vessel the extraordinary speed of 341 knots. The after part of the vessel and both sets of machinery have recently been presented to the Science Museum,

November 15, 1850.—In the ring of Saturn, first observed by Gahleo, can be distinguished three rings, an outer ring called A, a middle ring B, and an inner ring C. This inner, or dusky ring, some 11,000 miles across, was first distinguished by Bond on Nov. 15, 1850

November 16, 1492—In the parish church of Ensishem in Alsace hangs the oldest known meteorite. Of this a contemporary document says, "On the 16th of November 1492, a singular miracle happened; for between eleven and twelve in the forenoon, with a loud crash of thunder and a prolonged noise, there fell in the town of Ensishem a stone weighing 260 pounds. . . It was taken to the church as being a miraculous object."

November 17, 1893.—Heaviside's writings are contained in his "Electrical Papers," covering the period 1872 to 1892, and his "Electro-magnetic Theory" containing his work up to 1912. In the latter is his historic paper of Nov. 17, 1893, in which he laid down the principles of the use of inductance coils in telephone circuits.

November 18, 1846.—Sulphuric ether had been known in the thirteenth century. It was recommended as an inhalant for asthma by Pearson of Birmingham in 1785, and it is said that Faraday in 1818 noted the effects of inhaling it. It was Prof. Jackson of Harvard who suggested to W. T. G. Morton the possibilities of other as an anesthetic, and on Oct. 16, 1846. Morton successfully administered it to a patient in the General Hospital of Boston, while the discovery was made known to the world by Dr. Bigelow on Nov. 18, 1846.

November 19, 1787.—"The advance of astronomy m the eighteenth century," wrote Miss Clerke, "ran in general an even and logical course. The age succeeding Newton's had for its special task to demonstrate the universal validity, and trace the complex results of the law of gravitation. The accomplishment of that task occupied just one hundred years. It was virtually brought to a close when Laplace explained to the French Academy, November 19, 1787, the cause of the moon's accelerated motion "With this work, says another writer, "the last anomaly and the last threat of stability thus disappeared from the solar system" E. C. S.

# Societies and Academies.

#### LONDON

Royal Society, Nov. 3.—Hans Spemann (Crooman Lecture): Organisers in animal development. The conception of 'organisers in development' has been derived from experiments in amphibian embryos in the earliest stages The different regions of such an embryo have not the same value for development. most of them are relatively indifferent and do not carry their destiny in themselves. This can be shown by transplantation of these parts into other regions of the embryo; they follow the development of their new environments. But there is a certain region in the embryo, parts of which, when transplanted into an indifferent region of the embryo, do not adapt themselves to their new environment, but retain their own character, and force, as it were, the others to follow them Such parts organise a new embryo, which is built up partly by the transplanted cells, partly by the cells of the host. Therefore they were called 'organisers,' and the region where they he together in those early stages of development the 'centre of organisation.' Further experiments have been made to determine the extent of this centre, its origin, its intimate structure, and the nature of the organising influence

#### Paris.

Academy of Sciences, Oct. 3.—Mesnager: Observations on a note by T J. de Sèze—H. Deslandres The law of distribution of magnetic storms and of their elements. Consequences to be deduced regarding the constitution of the sun.—Paul Helbronner The operations of the detailed geometrical description of the French Alps (twenty-third season, 1927) -Paul Montel: Subharmonic functions and their relations with convex functions—Pierre Humbert Spherical prepotential—L. d'Azambuja: The structure of the solar chromosphere.—E. M. Antoniadi The rotation of the third satellite of Jupiter. Observations made on this satellite during the last year with the 83 cm. telescope at Meudon Observatory show that this moon always presents the same face to Jupiter, except for a possible libration in latitude. It is concluded that the period of rotation of the third satellite of Jupiter is equal to that of its revolution round the planet.—G. W. Ritchey. Some mechanical and other advantages of the small length and compact structure of the Ritchey-Chrétien type of a planatic telescope.—Jean Thibaud and A. Soltan: Spectrographic measurements in the intermediate domain (series K, L, M, N).—Fred Viès. The optical properties of certain colouring matters susceptible of changing colour in concentrated solutions of neutral salts.—W. Ipatieff and B. Mouromtseff: The formation of crystallised silicates in aqueous solution under high temperatures and pressures. Silica gel, after heating for 30 to 40 hours at 310°-320° C., under a hydrogen pressure of 200 atmospheres gives hexagonal prisms and pyramids of SiO<sub>2</sub>. Replacing hydrogen by carbon dioxide, a crystallised hydrate, 5 SiO<sub>2</sub>, 2 H<sub>2</sub>O is obtained. The preparation of crystallised silicates of magnesia, calcium, manganese, and zinc is described.—Erling Botolfsen: The sublimation of iron in a vacuum. When iron is heated in a high vacuum at 1300° C., below its melting point, it slowly sublimes. In one experiment under these conditions the velocity of sublimation of iron was 0.07 per cent per hour.—Jean Cournot and Macedo Soares Silva: The viscosity of nickel, aluminium, and the light alloys.—P. Lebeau and A. Damiens:

The existence of a compound of fluorine and oxygen (NATURE, Nov 5, p. 672) -- René Van Aubel genesis of the uraniferous deposits of Kasolo (Katanga). Cubic uranimite is considered to be a pseudomorph --L Picard and R. Soyer. The presence of the Jurassic and of the lower and middle Cretaceous on the western slope of Antiliban - Jacques de The stratigraphical position of the Lapparent bauxites of the Pays de Fenouellet -- Ch. Jacob and L Mengaud The structure of the massits of L Mengaud Mont-Perdu, Sestrales, and the Tendeñera in Haut-Aragon - Henri Marcelet. The chemical analysis of the mud collected on the upper terrace of the Musée Océanographique of Monaco, following the storm of Oct 31, 1926 This brown mud left behind after the storm was free from organic matter, and consisted mainly of silica (46 per cent.), calcium, and magnesium carbonates (36 per cent.), with some alumina and oxide of iron. R. Argaud and G Billard The lymphoid stages of the digestive tract— G Athanassopoulos A somatometric character of Nereus.—M. and Mme. A Chauchard: Cerebral motor localisations in the lower vetebrates.—Alfred Maubert: The influence of thorum X on the activity of emulsin. At very low concentrations the total radiation of thorium X has a slight accelerating effect on the reaction between emulsin and amygdaloside; at higher concentrations the activity of the emulsm is reduced and finally destroyed. The accelerating influence is proved to be due to the  $\alpha$ -radiation only.—Jean Feytaud and René Dieuzeide: A parasitic fungus of Reticuliternes lucifugus.—A. Paillot. Two new Protozoa, parasites of the eaterpillars of Pyrausta nubilalis.—Edouard Chatton and André Lwoff: The evolutive cycle of the Infusoria Fættingeria actiniarum. The necessity for a second crustacean host.—Etienne Wolff. The behaviour and the rôle of the contractile vacuole of a fresh-water amorba Experiments are described proving the influence of the osmotic pressure on the contractile vacuole. Its function appears to be that of a regulating organ, designed to increase the osmotic pressure of the internal medium.

Oct. 10.—The president announced the death of Svante Arrhenius, correspondant in the Section of Physics. - Ch. Fabry: The calculation of the heat evolved by high frequency currents. A theoretical explanation of some results recently given by M. d'Arsonval.—H Douvillé: The marble of Sarrancolin and the limestones of Haute-Garonne. —L. Féraud: The  $C_{23}$  correspondences between the surfaces of space in four dimensions. —W Goloubeff: A limited automorph function.—Grialou: Plane rotational movement of liquid possessing viscosity, the regime being permanent and the trajectories vertical.—Th. De Donder: The fundamental equation of quantic chemistry. -G. P. Arcay and P. Etienne: The rigidity of liquids.-F. Croze and C. Mihul: Abnormal doublets and intercombinations in the spectrum of OII.-E. Darmois and R. Descamps: The natural rotatory dispersion of the molybdo-malic complexes. An extension of earlier measurements into the ultraviolet. The dispersion found was much higher than that given by the inverse square law.—Pierre Bricout: The quantitative study of the luminescence of mercury vapour excited by electronic shock.-R de Mallemann: The electrical double refraction of benzil.-Josef Hrdlička: The action of potassium permanganate on the photographic plate and infringements of the law of reciprocity. -A. Andant: The application of fluorescence spectroscopy to the examination of powdered alkaloids. A detailed account of the

technique of the method is given, extremely small quantities of alkaloids can be examined by this method, which promises to be useful as a means of analysis - Ed. Chauvenet and E. Duchemin: The purification of beryllia Starting with commercial beryllia containing 1.5 per cent, of impurities (mainly iron, aluminium, and calcium), heating in a cuirent of phosgene at 450° C. removes the iron and aluminium as volatile chlorides The residue extracted with water leaves pure beryllia.-J. Bougault: Benzalphenylethylsucenne and benzylphenylethylmalere acids—Mine Ramart-Lucas The mechanism of molecular transformations -- F Blondel: The geology and metallogeny of the zinc deposit of Cho Dien (Tonkm) E Bruet: The nature and the age of the sediment of the plateaux to the north-east of La Ferté-sur-Aube Pierre Lesage Curves of growth and heredity of the precouty character in very different latitudes.--P. Lasareff: The theory of the stimulation of nerves and muscles by electric currents of high frequency and short duration—Lesbouyries and Verge: The filtering forms of Koch's bacillus in canine tuberculosis - André Jousset : Researches on pulmonary anthracosis

# WASHINGTON, D.C.

National Academy of Sciences (Proc., Vol 13, No. 9, September). -E. S. Castle: The interrelation of the eyes of Palæmonetes as concerns retinal pigment inigration. Plaster of Paris and lampblack makes a harmless eye covering, and in Palæmonetes with one or both eyes covered, the pigment in the covered organ takes up the position occupied by the pigment of eyes adapted to darkness. Leaving one eve uncovered does not affect pigment movement in the covered eye.—Henry Federighi. The blood-vessels of annelids. Annelid blood-vessels generally and vertebrate capillaries are similar both histologically and physiologically. Both consist of an endothelium with a layer of isolated cells. In Nereis wrens, contraction of contractile vessels is independent of central nervous control and is of two types, (a) peristaltic, due to the endothelium; (b) local, due to the isolated cells (Musketzellen) and actuated by direct stimulation.—Jan Schilt: The effect of a rotation of the galaxy on proper motions in right ascension and declination B Knaster and C. Kuratowski - Remark on a theorem of R. L. Moore. The theorem refers to indecomposable continua. Gordon T. Whyburn Concerning the open subsets of a plane continuous curve.—S Lefschetz. On the functional independence of ratios of theta functions. -E. (' Watson and J A. Van den Akker: The direction of ejection of X-ray electrons. Magnetic spectra of the electrons ejected by X-rays from exceedingly thm metallic films show that the most probable direction of ejection is a little forward of perpendicular to the direction of the X-ray beam and is the same whatever level in the atom the electron comes from and whether the absorption energy is large or small. It is difficult to explain these results if the electronic orbits are regarded as having physical reality -William Duane: The character of the general, or continuous spectrum radiation Electrons from a hot wire cathode were shot into a stream of mercury vapour at very low pressure and the radiation produced by impacts of electrons and mercury atoms was observed by an ionisation chamber. The voltage applied to the tube was less than 12,000 volts (the  $\hat{L}$ -series of mercury require at least 12,300 volts and any M-series radiations were absorbed), so only general radiation was measured. Under these conditions, with many impacts, the electron transfers almost all, if not all, of its kinetic energy to the quantum of radiation produced, which appears to be very nearly mono-

chromatic -- G. H Dieke and Harold D. Babcock The structure of the atmospheric absorption bands of oxygen. - Charles E. St. John: Revision of Rowland's preliminary tables of solar spectrum wave-lengths. The starting point of Rowland's system (1893) was the mean wave-length of the  $D_1$  line of sodium as referred to the standard metre by five observers. In 1893, Michelson and Benoit, and in 1907, Benoit, Fabry, and Perot, using a Michelson interferometer, obtained the absolute wave-length of the red cadmium line in terms of the mètre des achives, and this was adopted as the primary standard in the international system of wave-lengths system of wave-lengths For many years now, measurements have been made at Mount Wilson, one series utilising simultaneous exposures to the centre of the sun and the standard iron are with the 30 ft and, later, the 75 ft. spectrograph, and the other interferometer measurements, and the results corrected for the rotation and orbital motion of the earth The results are to be issued shortly by the Carnegie Institution of Washington as a "Preliminary Table of Solar Spectrum Wave-lengths."—George de Thierry Application of the law of similitude to hydraulic laboratory research -A. Keith Brewer: Some factors influencing the ignition of carbon monoxide and oxygen. The ignition point of an explosive mixture of carbon monoxide and oxygen, using a condensed discharge, is, at constant pressure, determined by the energy of the spark, while at different pressures the ignition points are related as the voltage. Water vapour as an impurity lowers the ignition point, the merest trace enabling the reaction to proceed to completion, whereas in the dried mixture there was seldom more than 10 per cent. completion. Other impurities may be (1) mert except that they absorb energy, increasing the ignition potential (introgen, carbon dioxide, chloroform, alcohol, etc.), or (2) oxidised in the explosion and thus lower the ignution potential (water, hydrogen, alcohol, carbon disulphide, etc.). The effect of alcohol depends on the amount of oxygen present. It is suggested that the lowering of ignition potential is brought about by the catalytic activity of 'new-born' decomposition products of the impurity.

# Official Publications Received.

#### BRITISH

County Borough of Halifax Second Annual Report of the Corporation Museums for the Year 1926-7 Pp 20+2 plates. (Halifax)
Report of the Marlborough College Natural History Society for the Year ending Christmas, 1926 (No 75) Pp 91+2 plates (Marlborough.) To members, 3s, to non-members, 3s
Journal of the Indian Institute of Science Vol 10A, Patt 3 Influence of the Sulphur Atom on Optical Robatory Power. By P. P. Shukla Pp 33-11 Sannas Vol. 10A, Patt 4 The Constitution of the Additioned by the Action of Sulphuric Acid on Camphorquinone By Madhay Balaji Bhagyat and John Lionel Simonsen. Pp 43-55. Sannas (Bangalore)

A List of the Serial Publications available for Consultation in the Libraries and Scientific Institutions of the Union of South Africa Compiled for the Research Crant Board of the Department of Mines and Industries by A. C. G. Lloyd New and revised edition. Pp 19+259. (Cape Town.)

Journal of the Society of Glass Technology Edited by Prof W. E. S. Turner Vol. 11, No. 43, September. Pp xx+vi+31 45+277-302+229-320+xx-xxx (Sheffield) 10s 60

Colony of the Gambia. The Annual Report of the Department of Agriculture for the Period January 1st, 1920, to March 31st, 1927. Pp. 53 (London The Crown Agents for the Colonies) 5s

British Honduras Annual Report of the Forest Trust for the Year ended 31st March 1927 Pp 22. (Belize, British Honduras.)

Report of the Council of the Natural History Society of Not humberland, Durham and Newcastle-upon-Type, intended to be presented at the Annual Meeting of the Society, 2nd November 1927 Pp. 10 (Newcastle-upon-Type)

Tanganyika Territory. Report of the Department of Agriculture for the Year ending 31st March 1927 Pp. 46 (London. The Grown Agents for the Colonies) 2s. 6d

Wigan and District Mining and Technical College Report of the Principal on the Work of the Session 1926-27 Pp. 24 (Wigan)

Battersea Polytechnic, London, S. W. 11 Report of the Principal for the Session 1926-27 Pp. 38 Examination Lists, August 1927. Pp. 36 (London.)

An Ministry Annual Report of the Meteorological Committee to the Air Council for the Year ended 31st March 1927 (MO 298) Pp 75 (London H M Stationery Office) 28 net.
University of London University College Calendar, Session 1927-1928 Pp 18x+8+476+18x1 coln8+40. (London Taylor and Francis)

Observatoire de Zi-ka-wei Annales de l'Observatoire astronomique de Zi-se (Chine). Tome 16 Cooperation de l'Observatoire de Zi-ka-wei a la revision internationale des longitudes Pp 1v+15b+17 planches

la revision internationale des longitudes Pp 1v+15v+17 planches (Zi-ka-wei) Classified List of Smithsonian Publications available for Distribution, September 15, 1027 Compiled by Helen Vunice (Publication 2022.) Pp 1v+29 (Washington, D C Government Printing Office) Bureau of Education Publications available September 1927. Pp 25 (Washington, D C Government Printing Office) Social Research Department Frist Annual Report. Pp 8. (Peking The China Foundation for the Promotion of Education and Culture) Reale Islituto Lombardo di Scienze e Lettere, Milano Nel centenario della morte di Alessandro Volta Discorsi e note del Presidente Berzolari, dei MM EE Grabs, le Murani, equi SS CC Somigliana e Volta. Pp 14º

della motte di Alessandro Volta Discorsi e note del Presidente Betzolari, dei MM EE Grassi e Murani, e dei SS CC Somighana e Volta. Pp 149 (Milano Ulrico Hoephi) Smithsonian Miscellaneous Collections. Vol 79 (whole Volume) World Weather Records Collected from Official Sources by Dr Felix Exner, Dr G C Simpson, Sir Gilbert Walker, H Helm Clayton, Robert C Mossman Assembled and arranged for publication by H Helm Clayton Published under Grant from John A Roebling (Publication 2913) Pp. vii+1199 (Washington, D.C Smithsonian Institution) Department of Commerce Bureau of Standards Circular of the Bureau of Standards Pp 16 (Washington, D C Government Printing Office) 10 cents

Buréau of Standards, No. 328. Testing of Messuring Tapes at the Bureau of Standards. Pp 16 (Washington, D C Government Printing Office) 10 cents.

Field Museum of Natural History. Report Series, Vol. 7, No. 1 Annual Report of the Director to the Board of Trustees for the Year 1926 (Publication 243). Pp 174+20 plates. Botanical Series, Vol. 4, No. 5 1 Various Spermatophytes, by J. Francis MacBride, 11 Mosses of Peru, by R. S. Williams. (Publication 244). Pp 198-139+8 plates (Chicago, III).

Department of the Interior. U.S. Geological Survey. Bulletin 787. Geology and Ore Deposits of the Mogolian Mining District, New Mexico By Henry G. Feiguson. Pp 14-100+25 plates. 65 cents. Water-Supply Paper 369. Surface Water Supply of the United States, 1923. Part 9. Colorado River Basin. Pp 14-184. 25 cents. Water Supply Paper 77-4. Surface Water Supply of the United States, 1923. Part 12. North Pacific Slope Drainage Basins. C. Lower Columbia River Basin and Pacific Slope Drainage Basins. C. Lower Columbia River Basins and Pacific Slope Drainage Basins in Oregon. Pp 14-144-14-13 plates 35 cents. Professional Paper 149. Conselation of Geologic Formations between East-Central Colorado, Central Wyoming and Southern Montana By Willis T. Lee. Pp. 14-84-35 plates. 50 cents. (Washington, D.C. Government Printing Office.)

Agricultural Experiment Station, Michigan State College of Agriculture and Applied Science. Circular Bulletin No. 104. Flues commonly found in D. Wellings. By Eugenia McDaunel. Pp. 15. (East Lansing, Mich.)

Bulletin of the American Museum of Natural History. Vol. 54, Art. 3. The Reptiles of Hainan. By Kirl Patterson Schmidt. Pp. 407-571+plates 28.30. (New York City.)

#### Diary of Societies.

# SATURDAY, NOVEMBER 12

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Southern District Meching) (at Town Hail, Chippenham), at 11.30

Royal Institution of Great Britain, at 3.—E Cammaeits The Main Features of Modein English Literature (II)

Physiological Society (at Institute of Physiology, Cardifl University)

# MONDAY, NOVEMBER 14

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5 -Col H S L

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5—Col H S L Winterbotham The Triangulation of Africa ROYAL SOCIETY OF MEDICINE (War Section), at 5—Major E C Lambkin. Recent Investigations into the Treatment of Genorithua. British Psychological Society (Education Section) (at London Day Trianing College), at 6—Dr. W S. Imman Emotional States and their Relation to Eye Symptoms and Diseases.

Institution of Electrical Engineers (North-Eastein Centre) (at Armstong College, Newcastle-upon-Tyne), at 7.—A H Law and J P Chittenden Higher Steam Pressures and their Application to the Steam Turbine

the Steam Turbine

INSTITUTE OF METALS (Scottish Local Section) (at 30 Elmbank Crescent, Gla-gow), at 7 30—A. Logan: Brass Foundry Practice.

RAILWAY CLUB (25 Tothill Street, S.W.), at 7 30—H. A. Vallance. London's First Railway-the London and Greenwich.

ROYAL SOCIETY OF ARTS, at 8.—Prof H C H. Carpenter: Alloy Steels, then Manufacture, Properties, and Uses (Cantor Lectures) (I)

SURVEYORS INSTITUTION, at 8.—E. S. Cov: Presidential Address.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Bristol)—

A. R. Cooper Electrical Equipment of Track on the Underground Railways of London

Medical Society of London—Clinical Evening.

#### TUENDAY, NOVEMBER 15

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5—Dr P C Varner-Jones: Village Settlements and the Tuberculons (Mitchell Lecture)
ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15—Sir John Herbert
Parsons. Light and Sight (III).
ROYAL SOCIETY OF MEDICINE, at 5 30—General Meeting

ZOOLOGICAL SOCIETY OF LONDON, at 5.30—Sir Arthur Keith and Dr. N. A. Dyce Sharp. Exhibition of Gordla Skulls.—H. Cott. Exhibition of Photographs taken on the Zambert—Dr. W. D. M. itthew. The Evolution of Mannials in the Eccenc.—F. N. Chasen and G. Boden kloss. Spitha Ventumeners.—Minimals.—A. Lovenidge. (a) Notes on East African Birds (chiefly Nesting habits and Stomach contents) collected 1926; (b) Notes on some East African Invertebrates collected 1927.

1927
INSTITUTION OF GIVEL ENGINEERS, at 6—D) OF Faber Plastic Yield, Shrinkage, and other Problems of Concrete and then Effect on Design Institution of Electrical Engineers (East Midland Sub Centre) (at Longhborough College), at 15—W Wilson Protective Gear Institution of Michanna Engineers (Manchester Meeting) (jointly with North-Western Centre of Institution of Electrical Engineers) (at Milton Hall, Minchester), at 7—W McCleiland The Applications of Electricity in Warships
ROYAL Photographic Society of Great Britain (Kinematograph Group), at 7—T F Langlands Demonstration of the Campio' Combined Kinematograph Camera and Projector

Instruction of Birchitcal Esciters (North Midland Centre) (at Hotel Metropole, Leeds), at 7-15
ROYAL INSTRUCTION OF GREAT BRITAIN, at 0-15 -- M. Paul Painleve Les Conceptions Modernes de la Matiere et de la Science Classique

#### WEDNESDAY, NOVEMBER 16

WEDNESDAY, NOVEMBER 16

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (ITSh District Meeting) (at 35 Dawson Street, Dublin), at 3 30

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4—Dr. S Williams The Milk Supply

MEDICAL SOCIETY OF LONDON, at 5—Lord Hewart. Criminal Law and Insanity (David Lloyd Roberts Lecture)

ROYAL METROROLOGICAL SOCIETY, at 5—Special General Meeting for consideration of Proposed Alteration and Additions to By-laws—Ordinary Meeting, at 5 15—Dr. C. E. P. Brooks. The Influence of Forests on Ramial and Run-off—C K. M. Douglas. The Second The Depression on the Night of Jan. 25 29, 1927—Dr. E. Kidson' The Groundation of the Atmosphere over Melbourne.

Geological Society of London, at 5.30—Dr. W. D. Lang, Dr. L. F. Spath, L. R. Cox. and Helen Marguerite Muir-Wood. The Beleminte-Marls of Charmouth. a Series in the Lias of the Disset Coast. Institution of Civil Engineers (Students' Meeting), at 6.30—J. R. B. Griggs. Address.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 0.30—J R. B. Grigs Address
ELectrical Association for Women (at E.L M A. Lighting Service Buleau, 15 Savoy Street), at 7—Miss J. Sharp and others The Care and Maintenance of Electrical Apparatus
Institution of Electrical Engineers (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 730.—A If Law and J. P. Chittenden. Higher Steam Pressures and their Application to the Steam Turbine Merseyside Aquarium Society (at 1 Falkland Road, Egremont), at 7.30—J W. Cutmore: Aquarium India (Lecture)
ROYAL MIGROSCOPICAL SOCIETY, at 7.30—Dr. J. A. Murray. Methods for the Demonstration of Bacteria in Flozen Sections—Miss K. F. M. Kirby. Plastid Development in Osmanda Spores—Dr. R. J. Ludford Cell Mignation in Tissue Cultures and its Relation to the Repair of Inquires to the Epiderius.
ROYAL SOCIETY OF ARTS, at 8.—Prof. Leonard Hill: Overcrowding in

ROYAL SOCIETY OF ARTS, at 8.—Prof Leonard Hill: Overcrowding in Public Conveyances.

G.B.C. Society for Constructive Birth Control and Racial Progress (at Essex Hall, Strand), at s.—Dr. Marie Stopes Brief Résumé of the Year's Events.—Mrs Helen Bowes Pease and others Discussion on A Consideration of the Position of Labour Women and Buth Control Buth Control

INSTITUTE OF CHEMISTRY (Annual General Meeting), at 8.

INSTITUTE OF CHEMISTRY (Annual General Meeting), at 8.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

FOLK-LORE SOCIETY (at University College), at 8.—Prof. R. W. Chamber-The Story of Offa: a Study of the Growth of a Folk Tale in England.

EUGENICS SOCIETY (at Royal Society), at 8.30.—Dr F. A. E. Crew.

Concerning Natural Immunities and Disease Resistance.

INSTITUTION OF MECHANICAL ENGINEERS (Bristol Meeting).—Six William Bragg: Application of X-rays to the Study of the Crystalline Structure of Materials (Thomas Hawksley Lecture).

#### THURSDAY, NOVEMBER 17

ROYAL SOCIETY, at 4.30.—Prof. T G Brown (a) Absence of a Linear Relationship between Graded Simple Reflex Flexions and the Relations thereof evoked by a Constant Extension Producing Stimulus; (b) Absence of a Linear Relationship between the Reflex Flexion Shortenings, evoked by a Graded Series of Flexion-producing Stimuli and the 'Inhibitory' Lengthenings of a Constant Extension Reflex evoked by the same Stimuli, (c) The Relation of the Magnitudes of Remaining Reflex Shortening in Two Antagonistic Muscles during Compound Stimulation.—Sybil Cooper and D Denny-Brown Responses to Stimulation.—Sybil Cooper and D Denny-Brown Responses to Stimulation of the Motor Area of the Cerebral Cortex.—To be read in title only —Prof. J. Lorrain Smith and T. Rettie: The Distribution of Lymphatics defined by Antolysis of their Contents Royal Institution of Electrical Enginesy (at Geological Society), at 5.30. INSTITUTION OF MINING AND METALLERGY (at Geological Society), at 5.30. INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Capt. B. S. Cohen: Apparatus Standards of Telephonic Transmission, and the Technique of Testing Microphones and Receivers

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS, at 6.—S. G. Viskel. The Application of High Pressures to the Reciprocating Marine Steam Engine

INSTITUTE OF METALS (Birmingham Local Section) (jointly with Birmingham Metallurgical Society and Staffordshire Iron and Steel Institute) (at Engineers' Club, Birmingham), at 7.—Open Discussion on Annealing Institute of Chemistry (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry) (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry) (Edinburgh and East of Scotland Section) (contly with Society of Chemical Industry) (Edinburgh and East of Scotland Section) (contly with Society of Chemical Industry) (Edinburgh and East of Scotland Section) (contly with Society of Chemical Industry) (Edinburgh and East of Scotland Section) (contly with Society of Chemical Industry) (Edinburgh an

Institution of Automobile Engineers (London Graduates' Meeting) (at Watergate House, Adelphi), at 7:30—II. G. Dunn. Motor Ommbus Design.—F B. Grint. Cellulose Enish to Ommubus Use.

Chimical Society, at 8.—B. Cavanagh (c) Differential Potentiometric Titration. Part 1. Simple Method. (b) Part II. Refined Method.—Miss F M. Hamer. A General Method for the Preparation of Carbo cyanine Dyes.

Royal Society of Tropical Medicine and Hydrenic (Laboratory Meeting) (at London School of Hydrene and Tropical Medicine, Endsleigh Gardens), at 8.15—Demonstrations by Dr. Mary V. F. Beattle, Major H. C. Brown, Dr. P. A. Buston, Dr. A. Castellam, Capt. W. Dye, Dr. H. M. Harschell, Col. S. P. James, Col. Clayton Lane, Dr. P. H. Manson-Bair, Dr. N. A. Dyee Sharp, Drs. J. Gordon Thomson and A. Robertson, Dr. V. B. Wigglesworth, and Dr. C. M. Wenyon.

Royal Society of Medicine, Effectio Therapeutics, Medicine, Surgery, and Orthopadics, Sections), at 8:30—Dr. A. E. Barlay (Electro-Theiapeutics), Dr. E. I. Spriggs (Medicine), Mr. Max. Page (Surgery), H. A. T. Faribank (Orthopadics), Dr. A. E. Barlay (Electro-Theiapeutics), Dr. E. I. Spriggs (Medicine), Mr. Max. Page (Surgery), H. A. T. Faribank (Orthopadics), Dr. A. F. Hurst and Dr. A. C. Jordan Special Discussion on Radiological Pittalls.

North-East. Coast. Institution of Engineers and Shipbuilders (at Newcastle-upon-Tyne)

Institution of Mechanical Engineers (Manchester Meeting)—E. McKle. Boiler House Economy

Institution of Mechanical Engineers (Manchester Meeting)—Sir William Bragg. Application of X-lays to the Study of the Crystalline Structure of Materials (Thomas Hawksley Lecture)

#### FRIDAY, NOVEMBER 18

Association of Economic Biologists (at Imperial College of Science),

Institution of Mechanical Engineers, at 6 -H Gutteridge Modern Portland Cement Plant ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Meeting

of Pictorial Group), at 7 .- A. Knapp The Graphic Representation of a Third Dimension

JUNIOR INSTITUTION OF ENGINEERS (at Canton Hall), at 730 -SII Mundoch Macdonald The Nile and the Use of its Waters (Presidential

MULGOEI MACCOIRIG THE FRIE and the Use of the Waters (A Friedman Inaugural Address).

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Chemical Society), at 8.—A. J. Broughall. Some Modern Methods of Recovery of Lubricating Oils

ROYAL SOCIETY OF Madicine (Electro-Therapeutics, Medicine, Surgery, and Orthopædies Sections), at 8.30—Discussion on Radiological Differing.

Pitfalls

Pitalis
Society of Dyers and Colourists (Manchester Section)—L. G. Lawrie
The Microscopic Investigation of Artificial Silk Fibres.
Institute of Chemistry (Leeds Area Section) (Annual General Meeting
(at Leeds)—H. Salt The Training of a Leather Chemist
Oxford University Junior Scientific Club—C. J. Allen British
Railways. their Locomotives and Engineering (Lecture) J. Allen British

#### SATURDAY, NOVEMBER 19

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 - ( Holst . Samuel Wesley and Robert Pearsall (I)
Brilish Mycological, Society (at University College).

#### PUBLIC LECTURES.

SATURDAY, NOVIMBER 1'

Horniman Museum (Forest Hill), at 3.30. - Mrs. R Aitken Dances of the Pueblo Indians

#### MONDAY, NOVEMBER 14.

Institution of Eigerfield Engineers, at 5:30—Sir William Hardy Physics in the Food Industry (Lecture No. 13 of the Institute of

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsfold), at 7.—Principal D B Johnstone-Wallace. Laying down Land to Permanent Pasture and the Use of Seeds Mixtures in Arab'e Faiming.

# TUESDAY, NOVEMBER 15

King's Coilege, at 5.30 —Miss Hilda D. Oakeley The Philosophy of Personality. (Succeeding Lectures on Nov. 22, 29, and Dec. 6)

#### WEDNESDAY, NOVEMBER 16.

KING'S COLLEGE, at 5 30 .- Dr. Dorothy Brock: Secondary Education . The Girls' School.
UNIVERSITY COLLEGE, at 5 30.—P. R. James The Decoration of Book-

bindings
LONDON SCHOOL OF ECONOMICS, at 6 —J J Sarjeant: Office Machinery Demonstration of the Barlock Typewriter

#### FRIDAY, NOVEMBER 18.

KING'S COLLEGE, at 5.30 -Dc. C. Anti. The Italian Excavations in Cyrene.

#### SATURDAY, NOVEMBER 19.

HORNIMAN MUSEUM (Forest Hill), at 330.-II N Milligan Common Mistakes about Evolution.

# CONGRESSES.

NOVEMBER 14 TO 19

Public Works, Roads and Transport Congress (at Royal Agricultural Hall).

DECEMBER 15 TO 24

JOURNLES MIDICALLS D'EGYPTE (at Cairo)



# SATURDAY, NOVEMBER 19, 1927.

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# Evolution and Theology.

THE recently published correspondence between the Bishop of Birmingham and the Archbishop of Canterbury has not been without interest for students of the natural sciences, since it sheds some light upon the attitude of the authorities of the English Church towards the results of scientific research. We are of course not concerned in these columns with spiritual faith or denominational belief, but it is appropriate to make clear the attitude now presented by leaders in the Church towards progressive scientific knowledge, and the best method of doing this may be to quote certain relevant passages from the correspondence in In parenthesis, and as a sign of the new spirit which now prevails between leading representatives of science and theology, it is sufficient to mention that Sir Arthur Keith, president of the British Association, is to take the chair on Monday next at a lecture to be delivered by Dean Inge on the subject of "Scientific Ethics."

Dr. Barnes's first letter to the Archbishop, occasioned by the outburst at St. Paul's Cathedral on Oct. 16, contains the following observations:

"One cause of the weakness of the Church has arisen from the apparent determination of teachers to ignore scientific discovery. Though all competent biologists accept man's evolution from an ape-like stock, the theological consequences of such belief are still seldom stated. I set myself years ago to expound these consequences and to show why they did not seem to me to upset the main Christian position."

To this the Archbishop replied that the Bishop was disturbing himself unnecessarily, since evolutionary views had won wide acceptance amongst religious people, and were now no novelty

"I believe that you overrate the adherence of thoughtful people to creation theories of fifty to a hundred years ago, and I scarcely think that among those who listen to you there are a great number who hold the opinions which you satirise. For myself, at least, I can say that your position on the biological question, in outline and so far as I understand it, is one with which I personally have been familiar for more than fifty years. Believe me, this teaching, however admirable, is to most of us not novel"

Although these remarks may be said to have evaded the issue raised by Dr. Barnes, yet they constitute a valuable pronouncement, admitting as they do the theological legitimacy of evolutionary opinions, and they were immediately welcomed as such by Dr. Barnes in his reply.

"I would publicly thank your Grace for your letter in answer to my own. By tacit acknow-

ledgment of the truth of the biological doctrine of evolution your Grace removes from Christian ministers of our Church any qualms in proclaiming it"

Dr Barnes then returned to the point alluded to in his former letter, a point which the Archbishop had allowed to escape him

"Of course in my sermons I have sought to emphasise not so much the doctrine itself as the readjustments of Christian dogma consequent upon its acceptance."

Since no official reply has been published to this further letter of the Bishop of Birmingham, the Council of the Churchmen's Union, a body of theological liberals under the presidentship of the Very Rev. Dr. Inge, Dean of St. Paul's, dispatched a letter to Dr. Barnes, which contained the following remarks

"You are blamed for preaching evolution to general congregations Now it is true that the accepted teaching of science on this subject has long been familiar to educated people who find no difficulty in reconciling it with the Christian faith. But the acceptance of evolution as a biological theory is often unaccompanied by any attempt to follow up the consequences of the theory in their bearing on traditional theological statements, and we believe that in making the attempt you are doing good service which is greatly needed at the present time"

The correspondence from which the foregoing extracts have been given seems to indicate a somewhat anomalous state of affairs. While biological theories of the evolutionary origin of man, and indeed of creation generally, appear to prevail among educated members of the Church of England, clerical as well as lay, no systematic attempt is being visibly made to modify the traditional dogmatic system in view of the new knowledge which radically affects it.

The pressing nature of the need for such theological restatement in view of knowledge which, as the Archbishop reminds us, is fifty years old, can escape no reflective person. We have only to consider how integral to the traditional dogmatic system is the doctrine of a historical fall of man. The Christian theory of human nature (that is, its need of supernatural grace, and so on) hangs upon it, while the scheme of redemption, involving a historical incarnation, is its dogmatic correlative. It is not merely a question of the earth having been created in six days or during incalculable periods of time—that issue, though it has been considered serious, is trifling compared with the others raised by the theory of evolution.

There has, of course, been much literature published dealing with different aspects of the subject.

Dr N P. Williams, the Regius professor of divinity at Oxford, devoted his recent "Bampton Lectures" to a historical and philosophical treatment of the doctrine of original sin, a book characterised, as Prof W. R. Matthews has observed, by "its frank acceptance of modern views of the world and its repudiation of ideas which have long been accepted in the Church" Canon Streeter also, in his book "Reality" (1926), includes some remarkably stimulating chapters which deal quite frankly with the problems of man's relation to Nature, and, above all, of the problem of evil—of which the Genesis myth is an attempted solution. This problem, which is so radically affected by evolutionary theories, Canon Streeter rightly regards as more. important than any other for religion Thus evolution touches the very heart of religion, and cannot be disregarded by religious teachers who take their task seriously.

If we may be permitted another example, it may be found in Dr. Major's "English Modernism," a work which contains lectures recently delivered at Harvard. Dealing with new ideas of creation, he registers "the acceptance of evolution as the Divine creative method, and the abandonment of instantaneous creation by successive Divine flats", and he observes that this "entails the acceptance of the fact that the creative process is still proceeding." This view, "although it seems modern, appears to underlie the theology of the Fourth Gospel," and is also in harmony with the remarkable passage in the eighth chapter of Romans, where creation is spoken of as still travailing in birth-pangs.

Yet in spite of these and other sincere and able efforts to find a new expression of Christian truth in terms of evolutionary science and philosophy, it seems to be widely held in authoritative circles (1) that the new doctrinal view should be disseminated only with extreme caution and reserve, and (2) that restatements of dogma would at present be highly. dangerous. It would seem to be against this overcautious policy that Dr. Barnes is in revolt. In advocating the bolder course, he will certainly have the sympathy of men of science, who are quite accustomed to frank restatements of doctrine; indeed, science has progressed by means of them As for the fears expressed for the faith of the weaker brethren, a remark made many years ago by Prof. Harald Hoffding seems apposite:

"No one wants to rob the poor man of his ewe lamb—only let him remember that he must not drive it along the high road unnecessarily and then demand that the traffic should be stopped on its account."

# History of Medicine.

An Introduction to the History of Medicine from the Time of the Pharaohs to the end of the XVIIIth Century By Dr. C. G Cumston With an Essay on the Relation of History and Philosophy to Medicine, by Dr F. G. Crookshank. (The History of Civilization Series) Pp. xxxii + 390 + 24 plates. (London: Kegan Paul and Co., Ltd, New York: Alfred A. Knopf, 1926) 16s net.

WE welcome the appearance of a work on the history of medicine by Dr C. G. Cumston, who, in addition to other qualifications for the task, was president of the fifth International Congress of the History of Medicine held at Geneva in July 1925 (see NATURE, Nov. 14, 1925, p. 729).

The book is divided into twenty-one chapters, in which the writer successively discusses Egyptian medicine, Hindu medicine, Greek and Roman medicine, Islamic medicine, medicine including physiology, anatomy, pathology, nosology, therapeutics, and surgery in the sixteenth and seventeenth centuries, and the principal medical doctrines of the seventeenth and eighteenth centuries A special chapter is devoted to the doctrine of irritability, the Brunonian theory, and naturalism, and another to organicism and vitalism. The concluding chapter consists of a brief survey of the evolution of therapeutics.

After an introductory chapter on the evolution of medicine, showing how it gradually advanced through the theological and metaphysical stages before reaching the positive stage described by Comte, Dr Cumston devotes a chapter to Egyptian medicine, in which he shows how the history of the healing art is to be found in the various papyri. The following chapter on Hindu medicine contains numerous quotations from the Vedas relating to medicine, such as the account of the birth of the Hindu Æsculapius, the duties of the playsician and nurse, plastic operations, and the legend of Jivaka, which shows that the operations of major surgery were at least known if not actually carried out by the ancient Hindus. The next chapters deal with Greek medicine, commencing with the philosophers, such as Theophrastus, Pythagoras, Heraclitus, Parmenides, Alcmæon, Empedocles, and Diogenes of Apollonia. A special chapter is devoted to the Hippocratic oath, which has always been the guide of the medical profession. In the following chapter, which is concerned with Hippocrates and the Hippocratic Collection, Dr. Cumston points out that naturalism was created from the time that Hippocrates demonstrated the existence of a formative, conservative, and medicative power inherent in the organism, by which it feels, reacts, and develops, preserves itself, and combats morbid causes and the effects produced by them

Among the direct successors of Hippocrates, with whom the next chapter deals, may be mentioned Aristotle and his disciple Theophrastus, who contributed indirectly to the progress of medicine by their studies in natural history, Diocles of Carystus, who was one of the first to make a scientific study of anatomy, and Praxagoras of Cos, who was one of the last of the Asclepiadæ whose name has been preserved. More importance, however, attaches to the school of Alexandria, of which Erasistratus and Herophilus were the most illustrious representatives, as it was from this school that the systematic study of anatomy emanated

An interesting survey is given in the succeeding chapters of medicine in ancient Rome, including the practice of Asclepiades, whose system was based on the teaching of Epicurus, the school of methodism founded by Themison and also represented by Thessalus, Athenæus of Cilicia, Archigenes of Apameia, Soranus, the author of a work on diseases of women, and Cælius Aurelianus, who wrote on acute and chronic diseases. The chapter on Galen contains an instructive comparison between him and Hippocrates. According to Dr. Cumston, Galen would certainly have equalled the father of medicine if he had had less imagination and independence of character, and had not been influenced by the philosophy of Aristotle. Galen explained facts by hypotheses, whereas Hippocrates observed the phenomena of Nature without explaining them. The result has been that the doctrine of Hippocrates has survived, but Galen's system of medicine has been completely destroyed.

In the chapter on Islamic medicine, Dr. Cumston controverts the view that the Arabians were merely servile copyists of the Greeks, and maintains that in addition to their methodical classification of the scattered elements of Greek medicine they created clinical medicine and enriched pathology with a knowledge of new diseases.

The medical schools of Salerno and Montpellier next receive attention, an interesting description being given of Trotula, Constantine the African, the Regimen Sanitatis, Roger of Parma, Guy de Chauliac, Sylvius, and Rabelais.

The chapters on medicine in the sixteenth century contain an account of the work of Jean Fernel, the author of "Universa Medicina"; Fracastor, the first scientific writer on the doctrine

of contagion and author of the celebrated poem on syphilis; Paracelsus, who helped in the advancement of medicine by introducing mineral substances into the therapeutics; and the great Italian anatomists. In discussing the medical doctrines of the seventeenth century, Dr. Cumston maintains that the three great contemporary schools of medicine, namely, the iatro-chemical, iatro-mechanical and vitalistic, and animistic schools, owed their existence to the three great philosophers Van Helmont, Descartes, and Leibnitz.

Dr. Cumston distinguishes three periods in the eighteenth century to illustrate the progress made in anatomy and physiology. The first period was that of direct continuation of the researches carried out during the seventeenth century, and was represented by Littré, Duverney, Verheyen, and especially Winslow and Sénac, who discovered the muscular fibres and valves of the heart. The second period was represented by Albrecht von Haller, who published his work on sensibility and irritability in 1752, while the third period, which covered the last twenty-five years of the eighteenth century, was remarkable for the discoveries of Lavoisier, Fontana, Priestley, Fischer, Vauquelin, and Abernethy.

Dr. Cumston may be congratulated on having succeeded in presenting the general reader and student of medicine, for whom the work is intended, with an admirably clear and thoughtful introduction to the study of medical history. The text is accompanied by excellent portraits and other illustrations, most of which are from the author's private collection.

# Australian and New Zealand Insects.

The Insects of Australia and New Zealand. By Dr. R. J. Tillyard. Pp. xin + 560 + 44 plates. (Sydney: Angus and Robertson, Ltd.; London. Australian Book Co., 1926.) 42s.

THE curious and beautiful insect fauna of Australia is perhaps the most attractive in the world. That of New Zealand, notwithstanding certain features of special interest, is on the whole rather disappointing and very defective, but its treatment in conjunction with the Australian relieves this difficulty. Both faunas are now so far known as to admit of their general features being set forth in a text-book, and also so far unknown as to offer a marvellous field for exploration to those possessed of such a guide The appearance of this volume, which is intended both for university students and for amateur naturalists, is well

timed, and it should cause a large expansion of local study

A full and lucid account is given of the general structure of insects, and the modifications characterising the twenty-four orders in which they are classed, illustrated by numerous clear and excellent drawings This, the most important part of the work, is also the best, and can be recommended to entomological students of any country, the fundamental details of the wing-neuration in particular are thoroughly explained. The broad lines of the scheme of classification employed are reasonable and intelligible. The characters of the orders are tabulated in the form of a general conspectus, and in each order the analysis is carried down to families by dichotomous keys. hence an unassisted student should find himself able to refer any insect to its proper family This method of procedure so much assists comprehension and saves so much time that it is unavoidable; but all who use such keys should be made aware that they can only be generally and not absolutely correct; exceptions are continually being discovered, and nothing in Nature is constant. Undoubtedly learners, especially when dull, like to have cut-and-dried formulæ, but they had better face the truth. They will also find that reliance on any single character is always risky. and that affinities must be judged by the sum of all characters, if they are to be natural

When we examine the internal arrangement of the orders, some errors are perceptible. Taking the Lepidoptera as an example, the butterflies are still classed as a separate division, Rhopalocera, equivalent in value to all the rest of the order except the primitive Jugata (Comstock's group, quite unnecessarily renamed by Dr Tillyard Homoneura), though the case is really given away on p. 455, where the probable relationship to the Pyraloid groups is admitted The definitely conclusive argument is, however, that when all other groups are considered separately, all are found alike impossible as ancestors of the butterflies, except the Pyraloids alone. Most authorities would also probably now admit that the skippers (Hesperiadæ) are not really from the same stock as the other butterflies, but from a related and more primitive one, the antennal club and loss of frenulum being adaptive characters and developed independently in each case. Again, the small jugal lobe quite correctly mentioned as present in early forms of Nepticulidæ (discovered by Miss Braun) might have warned the author that these highly interesting little insects (with quite unique

neuration) cannot possibly be degraded Tineoids; they are an original development from Micropterygidæ, and must form a separate primary division; their universal distribution is part of their antiquity. The singular little Epipyropidæ, confined to Australia, the larvæ of which are parasitic on Hemiptera, cannot be included among the Tineoidea, the neuration, absence of palpi and tibial spurs, and all other characters refer them to the Psychoidea, certain forms of which they closely resemble. Nor does the inclusion of the Drepandæ in the Noctuoidea seem to have any other merit than that of novelty, the type of neuration approximates to the Pyraloid.

Under each family are given some few details of striking or interesting species, and there are coloured and plain plates acquainting the student with the general aspect of many of these, which are probably intended to stimulate popular interest. These items of general information appear sometimes untrustworthy. Corrections under the Lepidoptera should be made as follows: Tinea fuscipunctella is not a clothes-moth, but a refusefeeder; the similar clothes-moth is T. pellionella. Ephestia cautella is certainly not identical with E. kuehniella, the so-called 'Mediterranean Flourmoth', it is the species formerly known as cahiritella Guen The attribution of Lysiphragma to the Elachistidæ, even in the wide sense (out-ofdate) in which this term is used, is quite unintelligible and cannot be intended; it is a true Tineid. The decaying family Copromorphidæ are twice stated to be confined to Australia and New Zealand; but even the first species ever described was from Fiji, and others have been recorded from the Papuan and Malayan regions, India, S. Africa, and S. America. The character by which this family is separated from several others in the key (presence of cubital pecten in hindwings) fails to operate. as the same structure occurs fairly frequently in one of them, the Gelechiadæ, for example in Dichomeris. It may also be noted that the characteristic compression of the third segment (terminal joint) of palpi in Glyphipterygidæ is not lateral but transverse.

It is gratifying that Dr. Tillyard has attempted to preserve orthography in nomenclature. Such forms, however, as Sericostomatidæ, Selidosematidæ (formed from Sericostoma, Selidosema), are really new errors, based upon the old error (corrected in Nature, vol. 41, p. 342, 1890) that such generic names are neuter substantives, whereas they are feminine adjectives; the stem of the Greek stoma is stomat-, but of Sericostoma

It is Sericostom. Another barbarism adopted from Hampson is that of the use of the terms Trifinæ and Quadrifinæ for the divisions of the Noctuoids called by Guenée quite correctly Trifidæ and Quadrifidæ; presumably on the supposition that -idæ is a family termination and therefore inappropriate, whereas -id- is of course part of the stem (fid-, denoting fission), and if the termination -inæ is desired, the correct terms would be Trifidinæ and Quadrifidinæ

Finally, in an interesting chapter on the geological history, Dr. Tillyard states his views on the origin of these two faunas. It is impossible to discuss them here; a long article would be required even to recite the difficulties that arise on their consideration. Why, for example, if both New Zealand and Tasmania were successively connected with Antarctica, should there be fifty species of Crambus (the origin of which must certainly have been thence) in New Zealand and none in Tasmania? More probably Tasmania was never so connected. We must leave such problems to be investigated by some of the philosophers who are to be called forth by this useful volume

Edward Meyrick.

# Science and Art of the Dyer and Colourist.

- (1) The Dyeing of Textile Fibres. By R S. Horsfall and L G. Lawrie. Pp. x +415 (London: Ernest Benn, Ltd., 1927.) 28s net.
- (2) The Dyeing of Cotton Fabrics. By Franklin Beech. Third edition, revised and enlarged by A. J. Hall. Pp xii+296. (London: Ernest Benn, Ltd., 1927) 18s net.
- (3) Textile Colour Mixing · a Manual intended for the Use of Dyers, Calico Printers and Colour Chemists. By David Paterson. Third revised edition. Pp. xiv+130+7 plates. (London: Ernest Benn, Ltd., 1927) 12s 6d net
- (1) TR. R. S HORSFALL and Mr. L. G. Lawrie, who are members of the staff of the British Dyestuffs Corporation, Ltd., the former being head of the dyehouse department of that firm, are peculiarly well-fitted for the compilation of a book dealing with the dyeing of textile fibres in general. The outlook of the average dyer must be limited largely to the activities within his own dyehouse, so that the types of dyeing upon which he is engaged and in which he is expert eventually become in his eyes the most important. As a result, although fitted to produce a specialised monograph dealing with the sections of the trade upon which he is engaged, he would be liable to produce an unevenly balanced general book on

dyeing. On the other hand, nowhere can such a varied experience of dyeing be gained as in the dvehouse section of a works where colouring matters are manufactured. It is here that colouring matters are submitted to the most rigorous examination in order to discover their good qualities or defects, and to elaborate the most suitable methods of application in the case of products of commercial value Further, the success of a colour works depends to a great extent upon close touch being maintained between the expert staff of its dyehouse section and all types of the colour consuming industries. Consequently, a most varied and evenly balanced experience of dyeing is gained, as is apparent in the book under review

The authors consider that most text-books attach more importance to dyestuffs than to the material to be dyed, with the result that the subject of dyeing the various fibres, cotton, bast fibres, artificial silk, wool, and natural silks, is approached through descriptions of the various classes of colouring matters. They have decided, therefore, to approach the subject from the angle of the material to be dyed, keeping in mind the manufacturing processes which the dyed material still has to undergo or the final uses to which it is to be put, with the view of simplifying the matter. Whether it is really a simplification to give excellent descriptions of machines without a single illustration, and to restrict the use of the formulæ of dyestuffs to the solitary example of aniline black, is open to debate, but that the authors have produced an outstanding book on dyeing cannot be questioned. It is written most attractively, and once its pages are opened it is difficult to lay it down unread. This thoroughly up-to-date book invites perusal and will be heartily welcomed by students of dyeing, whilst the general science reader who desires to know something of the science and art of dyeing as practised at present, can turn to no better source of information.

(2) Mr. A. J. Hall, on the other hand, has laid himself open to criticism in attempting to revise Mr. Franklin Beech's book. The first edition, published in 1901, described various processes and operations involved in dyeing cotton fabrics, from a practical and empirical point of view, rather than a scientific one, and may have been of service to evening students in technical schools at that date. Actually, the limited and unsatisfactory revision which has been carried out has altered the original character but little, whereas such drastic treatment as to render the original text unrecognisable

would have been necessary to convert this into a modern text-book. The publishers would be well advised to discard this book and arrange with Mr. Hall to write a new one

(3) Mr. David Paterson's well-known little book on colour mixing, in which he deals with his subject in a simple and practical manner, has proved a useful manual for elementary students since it first appeared in 1900 Although the original style has been preserved, the opportunity has been taken to revise the text somewhat without materially affecting its length. The dyed patterns used as illustrations of the text were dyed with German dyes in the first two editions, but are now dyed with colours of British manufacture, whilst further signs of the times are the increase in the price from 7s. 6d to 12s. 6d. since the second edition appeared in 1915, and the use of fewer coloured plates. Those engaged in the application of colouring matters cannot afford to neglect the subject of colour from a purely physical point of view. The first few chapters give an elementary account of colour, absorption spectra, and the spectroscope, and with this as a basis the remainder of the book deals practically with the mixing of lights, dyes, and pigments.

Although it is true that skill in dyeing and colour mixing cannot be acquired from books alone, knowledge such as can be acquired from the first and third of the books on this list is indispensable if young men are to cope with present-day conditions in the colour-using industries. F. M. Rowe.

### Cultivation of Sugar-Beet.

Handbuch der Zuckerrübenbaues. Unter Mitwirkung von Dr. A. Schaumburg. Bearbeitet von Prof. Dr. Theodor Roemer. Pp. v + 366 + 8 Tafeln. (Berlin: Paul Parey, 1927.) 19 gold marks

ANY considerable work dealing with the selection, culture, and manuring of sugar-beet is certain to arouse interest in England, now that our own sugar-growing industry is developing with such great speed. In some six years our area under the crop has increased from about 8000 to 126,000 acres, and even those farmers who have been growing it since the starting of the Cantly factory in 1910 must confess to a considerable ignorance of the principles underlying the cultivation and manuring of it. Recently, many inquiries on the subject have been addressed to the various centres of agricultural teaching and research, and there has been some difficulty in obtaining trustworthy information.

Dr. Roemer, with a full century of continental experience behind him, attacks the whole subject in a patient and thorough manner, and quotes the chapter and verse of laboratory and field experiments in support of most of his statements and recommendations

In the department of manuring he owes much to Schneidewind, several of whose opinions and experiments he quotes, while in the realm of cultivation he has drawn on the work of Wollny and a host of other continental workers In the matter of manuring, Dr Roemer stresses the fact that an excess of nitrogen and its late application leads to poverty of sugar content, delayed maturity and poor keeping quality, points which were well confirmed in an experiment at Rothamsted carried out only last year. In other particulars of manuring he recommends a moderate use of phosphate to ensure good texture in the root and to help maturity, and he thinks that a shortage of available potash leads certainly to a lowering of the sugar percentage in the root

In regard to spacing the roots in the field, Dr. Roemer favours a wider setting of the rows than most continental experts 20 in ×9 m. is the actual spacing that he names, and this compares curiously with the 14 in.  $\times 8$  in. and 16 in  $\times 8$  in. which have been recommended by many of the Dutch and German experts. Many British growers have objected to these very small spacings on the ground that it is practically impossible to use horse labour in the narrow rows, and that additional hand labour is very expensive and slow even when it is available. It is interesting to observe that Dr. Roemer supports his practical recommendation with a similar statement of labour difficulties in Germany. Throughout the book he makes great play with the necessity that exists for improved mechanisation • in the handling of the crop in the interests of speed and labour saving, and he has a number of interesting things to say about spacing drills, singling machines, and mechanical harvesters. In this last and very important particular he considers that the problem of mechanical harvesting of beet is now solved, and that we only wait for improvements of the existing machines

Taking the book on the whole, it appears as a very valuable addition to a section of agricultural literature which is not well represented in Great Britain, and it seems reasonable to expect that many of Dr. Roemer's conclusions will apply quite closely to sugar-beet growing in British conditions.

C. H.

#### Our Bookshelf.

Spectroscopy. By Prof. E. C C. Baly. (Textbooks of Physical Chemistry) Third edition. In 4 volumes. Vol. 3. Pp. viii +532 +6 plates. (London: Longmans, Green and Co., Ltd, 1927.) 22s. 6d. net

The third volume of Prof. Baly's "Spectroscopy" has followed very quickly upon vol. 2, a review of which appeared in our issue of Aug. 6, p. 185. It includes only four chapters, on series of lines in spectra, on the Zeeman and Stark effects, and on emission band spectra, but, since the first of these chapters covers more than 300 pages, the volume is rather larger than its immediate predecessor volume starts inevitably with Balmer's discovery of the first spectral series in 1885, but records an evergrowing acceleration which must have made it very difficult for the author to leave off writing and let his work go to press In order to do justice to the work of the pioneer investigators, he has rejected the tempting option of beginning with Bohr's first application of the quantum theory to spectroscopy in 1913, and has told the complete story of the work done by Rydberg, Kayser, Runge, Paschen, Fowler, and Millikan in the period when experiment rather than theory was the order of the day.

The main portion of the volume, however, is necessarily based upon the Bohr theory and its developments; and those who have tried with only moderate success to grapple with these developments will appreciate the 'humbleness of mind' which the author admits in his preface. He has, nevertheless, been able to complete this portion of his task within a reasonable time, and may be congratulated on his success in dealing with a situation which he could not possibly have foreseen when in 1905 he wrote a single volume on spectroscopy for this important series of monographs. It is, indeed, a noteworthy fact that the task of keeping abreast with the most active section in pure physics should have fallen to the lot of a chemist, writing (under the editorship of a chemist) a text-book of physical chemistry, and that his courage and skill should have proved adequate to this formidable task

Hydro-Electric Handbook. By William P. Creager and Joel D. Justin, with the Assistance of nine Contributors Pp. xxiv + 897. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 40s. net.

A BOOK verging on 900 pages provides scope for much matter, and the designation "Handbook" rather inadequately describes the wealth of information which is to be found in the volume before us Although bearing the names of two authors, it is really a compendium by them and nine other contributors, covering in its thirty-five chapters almost every subject and topic connected with hydro-electric development works. It is essentially an engineering manual, based on the wide field of experience obtainable in North America, where water power is an important natural endowment and is being exploited for

industrial purposes on a scale of magnitude greatly exceeding anything that is feasible in Great Britain

The mere enumeration of chapter headings would occupy almost the whole of the space available for a short notice, and it is only possible to indicate a few of the more important items which are treated by the various writers. There is an introductory section on rainfall, evaporation, and run-off, illustrated from United States records, together with a description of methods of estimating stream and flood flow, with the resultant yield of data respecting storage and power available for development. A short résumé of principles of hydraulics is then followed by four chapters dealing with different types of dams, and thereafter come descriptions of various other constructional features and power-developing equipment, including turbines and generators, extending to power transmission lines.

In brief, the book is a very complete and concise summary, from the American viewpoint, of the theory and practice of water-power supply at the present day. It is excellently printed and produced. The diagrams also are clear, and in some instances are duplicated, so that one copy may be detached for pocket use.

BRYSSON CUNNINGHAM.

In Search of our Ancestors: an Attempt to retrace Man's Origin and Development from Later Ages back to their Beginnings. By Mary E. Boyle. Pp 287 + 4 plates (London, Bombay and Sydney. George G. Harrap and Co., Ltd., 1927.) 10s. 6d net

MISS BOYLE has reverted to the practice of a former day in archæological exposition by working backwards. Her search for our ancestors begins with the Iron Age and traces them back through the various stages of culture of metal and stone to Quaternary and Tertiary man with their coliths, and then to the earliest forms of life in the tertiary, secondary, and primary periods. The Abbé Breuil, in a foreword, commends the author's method of attack on the ground that it leads the student back ultimately to the principle of unity and the first cause. With all deference to so great an authority, we would dissent. In dealing with prehistoric culture, the sense of development, the evolutionary process, even as a 'way of knowledge' as the Abbé defines it, to a great extent is lost when we work back from the complex to the more simple.

Apart from this point of method, Miss Boyle's treatment of her subject is eminently skilful, and she has handled the mass of detail now available in a masterly fashion. She deals, however, in the main, with Europe only, and that from the cultural side. Ethnological questions are not taken into account. This no doubt must be held to account for some omissions and for the fact that references to Egypt and Africa are incidental only. Yet it is difficult to see why recent discoveries at Ur and Kish, important as they are for the early use of copper and bronze and their relation to the use of stone, are not mentioned, although there is an adequate summary of the evidence from Hissarlik.

Navigational Wireless By Dr S. H Long. Pp. x1+164+12 plates (London: Chapman and Hall, Ltd., 1927) 12s 6d net.

The scope of this book is not so comprehensive as the title suggests, since the book deals almost entirely with the application of wireless direction-finding to marine navigation, and the book is intended to provide mutual instruction to the wireless operator and to the navigating officer. After two introductory chapters on general electricity and the application of valves and methods of screening to wireless receivers, the principles of direction-finding and the various available systems are described. The next two chapters deal with the installation of the Siemens direction-finder on board ship and the calibration of the instrument to determine the quadrantal error curve due to the metalwork of the ship.

The navigational side of the subject is treated in chapters vii., viii, and ix, which describe the various charts necessary in plotting off bearings at sea, and the method of applying corrections to the charted bearings. In the following chapter a description is given of the various effects on wireless bearings encountered in practice, but here many of the results of recent research on the subject have been omitted. The necessity for the provision of beacon transmitting stations for the use of ship's direction-finders is mentioned in the concluding chapter, which also contains a brief description of some sound-signalling devices.

The book has been well produced with a large number of excellent photographs and diagrams, and only one or two misprints have been noticed.

R L S.-R.

Der Erde Eiszeit und Sintflut ihre Menschen, Tiere und Pflanzen. Von Dr. O Hauser. Pp. vii + 370 + 22 Tafeln + 2 Karten. (Berlin: George Stilke, 1927) 16 gold marks

For the layman who can read German, and is not deterred by Germanic characters, Dr. Hauser has provided an extremely interesting survey of early human types and history. The introductory chapters include a brief summary of historical geology and of the evolution of life forms. Considerable attention is given to the Wegener hypothesis of continental drift, the treatment leading up to a discussion of the 'new world' of the Tertiary period and the acceleration of progress in the world of life that accompanied the far-reaching geographical changes of the time. The next revolutionary event was the onset of widespread glaciation that began a new period and saw the effective beginnings of mankind.

In dealing with Palæolithic man, Dr. Hauser is thoroughly up-to-date, for he appears to have made use of all the evidence available up to the middle of 1926. He is particularly interested in the art and culture of early man, and by plotting the localities of significant discoveries he attempts to follow up the migrations of some of the recognised races. The book is beautifully printed and illustrated, and is a thoughtful contribution to the literature of its

subject.

#### Letters to the Editor.

[The Editor does not hold himself responsible for opinious expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE No notice is taken of anonymous communications]

#### Variation of Intensity Ratios of Optically Excited Spectrum Lines with the Intensity of the Exciting Light.

In a recent paper on the optical excitation of mercury vapour (*Phil. Mag*, Sept 1927) I directed attention to the fact that lines excited by two successive processes of absorption should increase with the square of the intensity of the exciting light, while lines resulting from a three-stage absorption should increase with the

cube of this intensity.

As an example of the last case, we may take the emission of the line  $\lambda 3650$  of mercury. The vapour of mercury at room temperature in a quartz tube, highly exhausted, is illuminated by the total radiation of a water-cooled quartz mercury arc. The absorption of the line  $\lambda 2537$  raises the electrons from 1S to  $2p_2$ , from which level they are raised to 1s by the absorption From 1s some fall to  $2p_1$ , a metastable level, with emission of \5461, and from here some are raised to the d level by the absorption of  $\lambda 3650$ , from which level they return to  $2p_1$  with emission of λ3650. If we move the arc away until the illumination of the vapour is reduced to one-half of its initial value, one would expect that the intensity of  $\lambda 2537$  would be reduced to one-half, of λ4358 and λ5461 to onequarter, and of \$\lambda 3650\$ to one-eighth of their initial values, for by reducing the illumination by one-half we have only half as many electrons raised from 1S to  $2p_2,$  owing to the reduced intensity of  $\lambda 2537.$  But  $\lambda 4358$  has been reduced by one-half as well, consequently there is but half as much light available for absorption by the reduced number of electrons in Lines resulting from a two-stage absorption process are thus reduced to one-quarter, and from a three-stage absorption to one-eighth of their initial values. Several observations bearing out this view were given, though a special investigation of the matter had not been made at the time.

Practically all of the light emitted by the tube results from two-stage or three-stage absorption. This accounts for something that has always surprised me, namely, the impossibility of obtaining a satisfactory amount of emission by forming an image of the lamp on the resonance tube by means of quartz lenses. I had attributed it the absorption of  $\lambda 2537$  by mercury vapour in the air, but the relations above

described amply account for it.

The phenomenon can be shown in a very spectacular manner by the very simple expedient of inserting a sheet of fine wire gauze, which is non-selective in reducing the intensities of the lines, first between the resonance tube and the eye, and then between the lamp and the resonance tube. We find that in the latter case the intensity of the emitted light is very much fainter than when the gauze is held between the eye and the tube. The gauze employed was of very fine copper wire, and transmitted about one-fifth of the light. When held between the eye and tube, the light was reduced to one-fifth, but when held between the lamp and the tube, the reduction was to one twenty-fifth; i.e. the light was almost invisible. A quantitative investigation of these relations is now in progress in collaboration with E. Gaviola.

R. W. Wood.

Johns Hopkins University, Oct. 16.

Biological Work in Russia, Siberia, and Turkestan.

My wife and I reached Leningrad early in July,

MY Wife and I reached Leningrad early in July, and left for England about the middle of September. In the interval we journeyed in Siberia so far as Lake Baikal, to Archan in the Buriat Republic, and to Tashkent in Usbekistan (Russian Turkestan). We visited the old town of Tashkent, where the women are veiled and the general aspect of things recalls the times of the Arabian Nights, until we notice the street cars, and entering a large mosque, find it converted into a cinema theatre, just then producing the American film 'Speed' We travelled far on the railways, more often in the 'hard' than the 'soft' cars, in one case for ten days, and talked with all sorts of fellow passengers, getting a good idea of the state of public opinion. We took long journeys in the springless country carts, seated on a small quantity of hay; and we slept in the houses of the peasants. Thus, although the time was short, we got a fairly good idea of the condition of affairs in U.S.S R. We were, however, on a strictly scientific mission, and what I have to say relates only to scientific work. The extent and variety of the biological investigations and institutions was greater than we could have supposed, and it seems worth

while to give some account of what we saw

I had heard of the University at Irkutsk, founded during the civil war, but was quite unprepared to see a great organisation, with numerous buildings and strong faculties. All this has come into being in less than ten years. At the head of the Biological Institute of the University is Prof. W. Schewiakoff, a zoologist of the first rank, well known for his magnificent studies of the Radiolaria, published in the series of Naples monographs. His wrife is a daughter of the famous zoologist Kovalevsky, remembered especially in connexion with Amphioxus. Prof. Schewiakoff has devoted himself to improving the facilities for teaching, and has developed a most beautiful series of anatomical preparations, with accompanying explanatory drawings. I have never seen anything more perfect of the kind, and all has been done with small funds and what we should consider extremely poor facilities. Thus one preparation, apparently in a museum jar, was really placed n a perfume bottle, with the top neatly cut off.
Prof. V. Dorogostaisky, whom I met later on the
shore of Lake Baikal, is a very keen zoologist, concerning himself with the domestication of fur-bearing animals, with the Baikal fishes, with the remarkable Amphipod Crustacea of Lake Baikal, and other matters. He showed me his exquisite series of watercolour drawings of Baikal Amphipods, many of them new. The paper will be published later by the Academy of Sciences at Leningrad. Prof. B. Swartschewsky, whom I met in Irkutsk, is also a zoologist concerning himself with the fauna of Baikal, and the author of important papers. I also met the botanist V. Jasnitsky, who is specially interested in algae, and has published on the plankton of Baikal and other matters. He has also a good knowledge of the local flowering plants, as I found when accompanying him in the field.

My wife and I were for some days guests at the biological station of the University of Irkutsk, situated on the shore of Lake Baikal. There we found a group of young people living happily together, investigating the fauna and flora, and doing excellent work. The beauty of the surroundings, and the endless fascination of Baikal, together with the good fellowship and enthusiasm in the station, produced an impression long to be remembered with pleasure. At Maritue, nearer the southern end of the lake, I visited the headquarters of the Baikal expeditions of

the Academy of Sciences, and was fortunate in finding there Prof. Nassonov, one of Russia's most distinguished zoologists. I used to correspond with him

about Coceidæ in the days before the War.

Later on we spent a week at Tashkent, in Usbekistan (Russian Turkestan). Here also I found a great University, developed since the War. There is also a very good laboratory of economic entomology, phytopathology, etc., which publishes excellent bulletins. One of its publications is an important illustrated work on the grasshoppers of Turkestan, by Uvarov, of the British Museum. The Tashkent Museum has been greatly developed in the last few years, and now contains very good collections illustrating the local fauna and flora, palæontology, works of art, etc. The director, Mr. Yankowsky, is a competent scientific man, specially interested in entomology. The Museum is called the Middle Asian Museum, and is officially connected with a society for the protection of ancient monuments and natural objects (in the language of the locality, Sred az com star-is). In this museum I was shown and allowed to study a series of the wonderful Jurassic fossil insects found near Galkino, in the neighbouring Cossack Republic. They have been largely collected and partly studied by Mrs. Besobrasoff, of the Faculty of Physics and Mathematics in the Central Asian University at Tashkent. She has described a new species of the extraordinary genus Kalligramma, while her sister has written a paper, shortly to appear, on the fossil fishes of the same deposit.

The entomologist at the University, Prof. N. N. Kuznetzov-Ugamsky, is especially interested in ants and sawflies, but has studied many other insects, and has written a paper describing a number of new bees of the genus Anthophora, a genus remarkably developed in Turkestan. Prof. Kuznetzov took mo on a collecting trip, and when I left, placed in my hands a large collection of Turkestan bees for study. Prof. N A. Keiser, zoologist at the University, is especially interested in hydrobiology, more particularly the Cladocera, but he and his students have collected in many groups. A party of 14 students, the majority women, went with him on an expedition to Lake Issik-Kul. He kindly handed me for study and report a series of land shells obtained on this expedition. Prof. Keiser gave me some account of the growth of his department. In 1918 they had only two rooms and 10 microscopes; now they have several rooms and 40 microscopes. About 500 students work in the department. The financial support is better each year. 1 was shown a collection of 500 large and

excellent charts made in the department.

In the Botanical Department I met Mr. Alexey Vvedensky, in charge of the herbarium. Within five years or so there has been built up a herbarium of about 20,000 sheets of Turkestan plants and 15,000 sheets of the flora of other regions or countries. Original work is being done and many new plants described. Numerous fascicles of "Herbarium Floræ Asiæ Mediæ" have been issued, together with pamphlets describing the plants when new, and giving full citations of literature when old. In the British Islands these are sent to Kew and Edinburgh; in the United States to the California Academy and the New York Botanical Garden.

During our stay both at Irkutsk and Tashkent, we were guests in the rooms of the respective branches of the Geological Committee. This organisation, centring in a very large building in Leningrad, is the Geological Survey of the U.S.S.R. It is purely scientific and non-political, doing work of the highest practical and theoretical importance. This year it has had about 200 geologists in the field. Our work

m U.S.S.R. was made possible by the hospitality and co-operation of the Geological Committee, and without this it is probable that we could have accomplished nothing. We were especially indebted to Mr Theodore F. Schwab, director of the branch at likutsk, who prepared matters for us before we arrived, so that we were given every advantage, and spared all friction and difficulty.

In Leningrad we of course visited the Academy of Sciences, and saw the famous zoological and geological museums—the mammoth taken from the ice of Siberia, the Baluchitherium skeleton of almost unbelievable size, the extraordinary great reptiles extracted from concretions of Permian age. The entomological collections are very fine and most excellently arranged; I spent some time examining the bees of the genus Andrena. I met several of the entomologists, but greatly to my regret missed Skorikov, the authority on Bombus, because the day he expected me was consumed in getting permission to leave the country. I was especially pleased to meet A. B. Martynov, the great authority on fossil msects and living Trichoptera. He showed me the amazing collections from the Jurassic of Turkestan, which open up a great new chapter on the lustory of insect development; and also the wonderful series of insects he found in the Permian concretions, a single block often containing numerous species, exquisitely preserved. I regard Martynov as one of the greatest masters of insect morphology of our times, and were I a young man I could think of nothing better than to study under his guidance.

We received great kindness at the hands of the veteran Dr. Karpinsky, the head of the Academy, and his daughter, Mme. Karpinsky. The latter is a sort of guardian angel to foreign scientific people visiting Leningrad, much as Mrs. Britton is to

botanists visiting New York.

The Lenngrad Botanical Garden, occupying 15 acres, is a great centre of botanical work, and its library is said to be second only to that of Kew. The grounds are now being reorganised by a force of 300 men, but we saw very good exhibits of the flowering plants of different parts of U.S.S.R. The hothouses are full of interesting things. We were taken over the gardens by Prof. Komaroff, well known for his important studies of the flora of Eastern Siberia and the Mongolian Region.

There is a small botanic garden at Tashkent, the principal exhibit being a fine *Victoria regia* water-lily in a tank in the open. Many of the trees (as honey-locust, box-elder, and Robmia) planted along the walks are of American origin. Near the gate is a fine specimen of the Asiatic *Juglans fallax* Dode.

T. D. A. COCKERELL. On s.s. Yamel, Thames Estuary, Sept. 23.

# 1/

#### The Maxwell Effect in Liquids.

CLERK MAXWELL many years ago surmised that viscous liquids in a state of flow should exhibit birefringence, and devised methods of observing the phenomenon. Vorlander and Walter (Zeits. Phys. Chem., 118, 1; 1925) have recently investigated no fewer than 172 liquids of known chemical composition by Maxwell's method, and their work has demonstrated conclusively that a great many pure liquids which cannot by any stretch of language be classed as colloids, exhibit birefringence when subjected to viscous flow. The Maxwell effect, as it may be called, is thus a characteristic property of pure liquids just as much as the power of exhibiting birefringence in strong electrostatic or magnetic fields. We wish

bers.

briefly in this note to indicate a molecular theory of the Maxwell effect we have worked out which has proved itself very successful in explaining the observed phenomena.

It is easily seen that the stresses in flowing liquid can be considered as equivalent to a set of tensions and a set of pressures acting perpendicularly to each other, and at angles of 45° to the plane of sliding. When the liquid consists of molecules which are highly asymmetric in shape, there would be a tendency for the molecules to orientate under the influence of this system of stresses in such manner that the longest dimension of a molecule tends to lie along the axis of tensions and the shortest one along that of pressures; because such orientation would evidently result in the fluid, regarded as a densely packed assemblage of molecules, expanding along the direction of tensions and contracting along the direction of pressures, thus allowing the system of stresses to do work. By considering the work done during such deformation by the acting stresses as equivalent to the change of energy of the molecules resulting from orientation under a system of couples acting upon them, we can determine the latter in terms of the viscous forces and the asymmetry of shape of the molecules; it being remembered that the orientation is opposed by the thermal agitation of the fluid and that the resulting equilibrium is to be determined statistically in accordance with the Boltzmann principle.

The birefringence of the fluid resulting from the orientation of the molecules under the viscous stresses and their known optical anisotropy, is then readily worked out on lines analogous to those used by Langevin in his theory of electric and magnetic double refraction. The final expression obtained in this way for the difference between the refractive indices  $n_t$  and  $n_p$  for the vibrations along the axes of tensions and pressures respectively, is:

$$n_z - n_p = \frac{(n^2 - 1)(n^2 + 2)}{5n\nu kT}$$

$$\begin{split} & n_{t} - n_{p} = \frac{(n^{2} - 1)(n^{2} + 2)}{5n\nu kT} \\ & \cdot \frac{(a_{1} - a_{2})(b_{1} - b_{2}) + (a_{2} - a_{3})(b_{2} - b_{3}) + (a_{3} - a_{1})(b_{3} - b_{1})}{(a_{1} + a_{2} + a_{3})(b_{1} + b_{2} + b_{3})} \cdot \eta_{c}^{v}, \end{split}$$

where n is the mean refractive index of the fluid,  $\nu$  is the number of molecules per unit volume, k is the Boltzmann constant, T is the absolute temperature,  $a_1$ ,  $a_2$ ,  $a_3$  are the linear dimensions of the molecule along the three principal axes,  $b_1$ ,  $b_2$ ,  $b_3$  are the optical moments induced in the molecule along these axes by unit field acting on it successively along the same three directions,  $\eta$  is the coefficient of viscosity and v/c is the velocity gradient

The birefringence calculated from our formula, utilising the optical anisotropy ascertained from observations on light scattering and the geometrical dimensions derived from X-ray data, comes out in excellent agreement with the determinations of Vorlander and Walter.

The extension of the theory to the case of colloidal solutions and gels is at present engaging our attention.

C. V. RAMAN.

K. S. KRISHNAN.

210 Bowbazar Street, Calcutta, India, Sept. 17.

#### The Excitation of Spectra by High Frequency Oscillations.

THE letter in Nature of Oct. 8, p. 510, from Prof. R. W. Wood and Mr. Loomis directs attention to the possibility of developing spectra by means of high frequency oscillations Work on these lines has been proceeding in this department for some time, and the results obtained with mercury as a 'trial horse' are

A short coil of copper tubing was wound round a horizontal hard glass tube through which a stream of mercury vapour was caused to flow. The coil was connected in parallel with a condenser, and oscillations were maintained in this circuit by means of a highpower three-electrode valve. The frequency of these oscillations was of the order of 106 cycles per second, the voltage applied to the circuit could be varied from 2000 to 10,000 volts, and the power input increased up to 3.5 kilowatts. The pressure inside the glass tube was adjustable by the admission of air, and the spectrum produced when the coil was activated was examined end-on by means of a quartz spectro-

Before a glow was visible, the resonance line λ2536 7 was photographed with a long exposure. An increase of the voltage applied to the circuit caused the appearance of a greenish glow, which was found to be due to the lines of the s and d triplet series in addition to this line; prolonging the exposure only resulted in more members of these series being recorded. A further increase in the voltage caused the colour of the glow to change to that of the ordinary mercury arc, the photographs now showing the resonance line, the s and d triplets, the lines of the S and D singlet series, and some combination lines. Only those combination lines were present, however, which involved the arrival and departure levels of the series lines present. When the voltage was still further

increased, more members of the triplet and singlet series were developed, together with additional

combination lines connected with these new mem-

Simultaneously excited, however, were also thirteen lines, which have not yet been allocated to any series or combination, though these have all been identified as being present in the ordinary mercury arc. Their wave-lengths were 3984 1, 3860 4, 3820 6, 3790 4, 3751 8, 3561 5, 3543.7, 3390 5, 3351 5, 2820 0, 2686.7, 2660 1, and 2540 4. They were all of very feeble intensity except the first, which was as strong as an early member of the triplet series. A step by step reduction of the pressure from 1 cm. to that of the vapour alone, keeping the voltage constant, produced the same effects as increasing the voltage when the pressure was constant. An increase in the temperature of the vapour also facilitated the development of the lines. The line λ3984·1 was abnormally affected by pressure; increasing the pressure caused it to fade much more rapidly than the other lines.

It had been anticipated that enhanced lines due to atoms in various stages of ionisation might have been obtained, especially near the circumference of the tube, but these have not yet been observed; further endeavours to obtain them will be made. is remarkable that although several of the lines of the p series are present in the ordinary arc with an intensity as great as that of some of the higher members of the s and d series, yet they have not been observed as being excited by this method, even when the exposure has been prolonged up to five hours. It is possible that they require higher voltages for their excitation than have been available so far.

It is apparent that this method of developing spectra is full of promise, and its extension to other elements than mercury, the spectra of which have not yet been analysed so completely, is proceeding. J. R. CLARKE.

Physics Department, University of Sheffield, Oct. 11.

#### The Mechanism of Formation of the Latent Photographic Image.

It is with great interest that I see in Nature of Sept. 24, p. 441, Dr Toy's letter with regard to the part played by the photo-electric conduction effect in the formation of the latent image on silver halide

At the Detroit meeting of the American Chemical Society on Sept. 10 last I read a paper in which I presented a tentative picture of a mechanism for the formation of the latent image based on the known facts of silver halide and silver sulphide An earlier paper on the same subject will appear in the November number of the Journal of the Franklin Institute.

E. P Wightman and R F. Quirk, at the American Chemical Society meeting in Sept 1926, stated in their second paper on "Intensification of the Latent Image on Photographic Plates and Films," that they believed that the sensitivity spots on silver halide grains contain some silver in addition to the silver sulplinde. W Clark independently, in his experiments on the action of oxidisers on the sensitivity and latent mage, supports this view of Wightman and Quirk. He concludes: "It appears, then, that the results obtained could be explained on the view that silver sulfide is present in the sensitivity substance provided it is postulated that there is also present something—say, silver—which is attackable by oxidisers of potentials too low to attack silver sulfide."

Assuming that the explanations of Wightman, Quirk, and Clark are correct, we have in our high sensitivity photographic materials to deal with the

silver | silver halide | silver sulphide in which silver and silver sulphide are in contact with each other. This system represents a photo-electric cell of the Becquerel type, in which silver is the cathode, silver sulphide is the anode, and silver halide is the solid electrolyte

In light, the potential difference between the electrodes increases, the conductivity of the silver halide increases (i.e. photo-conductivity), and an electric current flows around in this closed system. The result will be an electrolysis of the silver halide, the cations moving towards the cathode (concentration speck theory; coagulation theory of the latent image), the anions losing their charge and staying in the crystal substance (Tubandt).

The photo-electric action according to the old

theory (Fajans) was

 $[Ag^+, halogen^-] = Ag + halogen.$ 

The halogen ion loses an electron, which moves towards the silver ion, thus discharging the silver cation. According to the above proposed theory, the electron from the halogen anion liberated by the light absorption moves towards the silver sulphide anode, then goes to the cathode; at the same time, the

Ag | Ag<sub>2</sub>S<sup>+</sup> [Ag+ Halogen-]

silver cation moves towards the cathode and is there discharged by the electron from the halogen anion. If the silver speck has grown to a certain size, developability is introduced.

This picture of the formation of the latent image also takes into account the failure of the reciprocity

law and the intermittency effect.

One of the difficulties in the photo-electric conduction theory of the latent image has been the wavelength effect, which has now been removed by the valuable work of Dr. Toy. A. P. F. TRIVELLI.

Research Laboratory

Eastman Kodak Company Rochester, N.Y., Oct. 13.

No. 3029, Vol. 1201

#### Some Further Spectral Lines of Trebly-ionised Germanium.

Carroll (Phil. Trans. Roy. Soc., vol. 225, p. 357) has identified the first members of each of the first principal, sharp, diffuse, and fundamental series of trebly-ionised germanium (Ge IV), which in Hund's notation may be represented by  $4S_1 - 4P_1$ ,  $2 \cdot 4P_1$ ,  $2 \cdot 5S_1$ ,  $4P_1$ ,  $2 \cdot 4P_2$ , 3 and  $4D_2$ ,  $3 \cdot 4F_3$ , 1 respectively. All these lines lie in the Schumann region. Using a condensed spark between metallic electrodes mvacuo, the near ultra-violet region has been examined for further spectral lines of Ge IV by means of a concave grating of radius 2 metres arranged on a Rowland mounting.

The first members of the second principal series  $5S_1$  -  $5P_1$ , 2 were easily found at  $\lambda\lambda 3554$  and 3676. A triplet resulting from combinations between  $4D_{2,\,3}$ and  $5P_1$ , 2 has also been identified. Taking Carroll's value 178094 for the wave-number of  $4D_2$ , the  $4D_2$ ,  $_3-5P_1$ , 2 triplet yields for  $5P_1$  and  $5P_2$  the wave-numbers 142242 and 141305 respectively. These terms combining with  $4S_1$  would give a doublet, namely, the second member of the first principal series, of wave-number 227396 and 226459. This doublet has been found by Dr. R J. Lang, to whom I am indebted for the measures of these lines and permission to include them in the table below. discrepancy between the estimated and measured wave-numbers of these lines is due to a lack of adequately accurate standards in the  $\lambda400$  region.

The measures are given in the following table.

Intensity	λI.A. air.	ν	$d_{\nu}$ .	Term Combination
8 9	3676·61 3554·14	27191·3 28128 2	936-9	$ \begin{array}{c c} 5S_1 - 5P_1 \\ 5S_1 - 5P_2 \end{array} $
5 5 1	2788 41 2736 09 2717 41	25852·2— 36537·7— 36788·9	$\begin{bmatrix} \cdots 936.7 \\ \cdot \cdot \cdot 251.2 \end{bmatrix}$	$\begin{vmatrix} 4D_2 - 5P_1 \\ 4D_3 - 5P_2 \\ 4D_2 - 5P_2 \end{vmatrix}$
1 1	441·95 440·11	226270 227216	} 916 {	$\begin{vmatrix} 4S_1 - 5P_1 \\ 4S_1 - 5P_2 \end{vmatrix}$

STANLEY SMITH.

University of Alberta, Edmonton, Canada, Sept. 30.

# The 'Green Flash' at Sunrise.

WATCHING the sunrise this morning across the Nile valley, under conditions of very good visibility and no local wind, using Goerz ×8 binoculars, I saw what is, to the best of my knowledge, a novel form of the 'green flash.'

From the top floor of Mena House Hotel the sunrise was behind Gebel Tura, with its skyline at about 300 metres elevation, and some 25 kilometres away. The dawn was clear, a light white mist lying low on the valley floor; the sky was cumamon colour, changing to amber as the sun rose; the desert hills appeared deep blue to the naked eye, and brownish purple through the field-glasses.

The form of the actual flash was totally unexpected; it preceded the emergence of the limb of the sun itself by perhaps as much as two seconds, and I can only describe it as resembling a shallow and turbulent river of apple-green water hanging ready to break over the hill crest. But this river flowed with a surface which seemed to follow the minor prominences of the skyline, instead of first appearing between them; it appeared suddenly, not seeming to widen much after its first apparition, the greatest width attained being perhaps one-third of the diameter of the sun's disc. At the emergence of the orange-gold disc in the centre of this pale-green band, the two colours seemed momentarily to co-exist, this was probably persistence of vision, but indicates that there was no eye-fatigue

The intensity of the green was never the vivid emerald of sunset which I have twice seen, once in the Mediterranean and once in Upper Egypt; it was the paler colour, which is less uncommon. Probably the actual intensity of the colour is a matter of luck. The fact of the flash appearing at sunrise seems finally to exclude any physiological cause, and agrees with the explanation of refraction through air layers of different temperatures. The apparent turbulence might well be real turbulence of the air, induced as the desert starts to be warmed by the sun's first rays W. Lawrence Balls.

Cairo, Oct. 26.

# Influence of X-rays upon Time-lags of the Faraday Effect and upon Optical Rotation in Liquids.

Differences in the time-lags of the Faraday effect behind the magnetic field in various liquids have been measured by Beams and Allison (*Phys Rev.*, 29, 161; 1927). Certain considerations have led me to suspect that these time-lag differences might be affected, and even reduced to zero, by the action of X-rays on the liquid. A number of experimental tests very recently carried out demonstrate that the X-rays have such a property. It was found in every case that the time-lag differences of the Faraday effect between any pair of the liquids vanished so long as the liquids were exposed to the X-rays, and that the lags were restored with the screening off of the X-rays. The liquids thus far used are carbon disulphide, carbon tetrachloride, ethyl alcohol, xylene, and chloroform.

The method also affords a means of measuring the absolute time-lags of the Faraday effect, giving values for the various liquids which are consistent with the previously measured time-lag differences.

This work having shown an influence of X-rays upon the lag of the Faraday effect, it was decided to find out whether these rays could produce an effect in rotating the plane of polarisation of light in these same liquids. A preliminary series of tests shows that a beam of X-rays traversing the liquids does impart to them the power of rotating the plane of polarisation, though it is small.

These investigations are being continued, and it is hoped that a detailed report of them will be published in the near future FRED ALLISON.

Alabama Polytechnic Institute, Auburn, Alabama,

Oct. 11.

# Synthesis of Rubiadin.

My attention has been directed to a paper in the August (1927) issue of the Journal of the American Chemical Society (p. 2043), in which Stauder and Adams have shown that rubiadin is not 1,3-dihydroxy-4-methylanthraquinone. It is of interest to record that we came to the same conclusion by condensing cresorsellimic acid with benzoic acid in presence of sulphuric acid.

1,3-Dihydroxy-4-methylanthraquinone melts at 265°-266° (not 251°, as found by Stauder and Adams) and the diacetyl derivative melts at 181°-182°. The deacetylation product melts at 265°-266°. We have also succeeded in synthesising rubiadin itself by condensing dihydroxyparatoluic acid with benzoic

acid (Schunck and Marchlewski's original method). Papers dealing with this work have already been communicated to the *Journal of the Indian Chemical Society*.

It is interesting to note that with the elimination of rubiadin from the list of  $\alpha$ -methylanthraquinone derivatives there is not a single natural product (of proved constitution) left in that list. Substances like emodin, chrysarobin, chrysophanic acid, etc., which have at one time or another been regarded as  $\alpha$ -methylanthraquinone derivatives, have all been since proved to be  $\beta$ -methylanthraquinone derivatives. It is curious to note in this connexion that while 3-methylanthracene occurs in coal tar,  $\alpha$ -methylanthracene is a purely artificial product.

P. C. MITTER.

University College of Science, Calcutta, Sept. 29.

#### Orientation of the 'Devil's Arrows,' Boroughbridge, Yorks.

At the recent meeting of the British Association at Leeds, Excursions Handbook Q was issued for members taking part in excursion No. 18 to Aldborough and the 'Devil's Arrows.' On pages 16 and 17 of this handbook there are remarks on this monument, and a plan of the positions of the three megaliths of which it is formed, for which we are responsible.

It is now found that the measurements and azimuths on which the plan was plotted are inaccurate, and that the positions of the three stones do not, as there shown, fall on the arc of a circle. The theory derived from this supposition, namely, that the three stones originally formed part either of a great stone circle or were the remains of the peristalith of a tumulus, must therefore be abandoned.

The 25-inch Ordnance Survey map of the site shows that the three stones are actually almost in alinement. From the northern monolith the azimuths of the other two he between 151° 00′ and 152° 30′, approximately, while the distance from the northern stone to the middle one is 200 feet, and from the northern to the southernmost is 570 feet (also approximately)

BOYLE T. SOMERVILLE.

#### An Active Form of Oxygen.

HERBERT E. WROOT.

An active form of oxygen, presumably monatomic, has been produced by passing oxygen gas saturated with water vapour through a discharge tube. The oxygen was generated electrolytically and subjected to a discharge of about 1000 volts at a gas pressure of  $0.4\,$  mm. of mercury. The gas was removed from the discharge tube through a side arm, and its density measured by passing it through a small hole which was located at a distance of 25 cm. from the discharge tube. Pressure measurements at the small hole indicated a decrease in the density of the gas corresponding to about 8 per cent. monatomic oxygen. A platinum calorimeter mounted over the hole showed a decided rise in temperature during the passage of the discharge. These effects were continuous throughout one 3-hour experiment. This work is being continued with the object of determining the most favourable conditions of studying the chemical properties of this gas. It is also hoped that a measurement of the heat of association may soon be completed.

F. R. BICHOWSKY. L. C. COPELAND.

Department of Chemistry, The Johns Hopkins University, Baltimore, Maryland, U.S.A.

# Research in the Textile Industry.1

THE eleventh annual report of the Committee of the Privy Council for Scientific and Industrial Research gives a comprehensive survey of the state of research in the various branches of industry, and of developments in industrial research since that Committee was established The record is both impressive and instructive. In its survey of the great productive industries it points out that "the textile industries, though the largest manufacturing industries of the country, are by contrast with other industries . . far more dependent on their own efforts for the prosecution of research and for the specialised training of their technical staff. While engineering, metallurgy, and industrial chemistry are considered suitable subjects for university research, there are no university organisations for research into textile problems except at Leeds and Manchester. There is no obvious reason for this, except that the subject from a scientific point of view is more difficult.'

At the recent meeting of the British Association, considerable attention was for the first time given to this subject of research in the textile industries. Several papers were contributed upon textile problems and the difficulties of research workers in the textile industry were emphasised. Attention was directed to the considerable volume of work which is being conducted by the Textile Institute and by similar professional bodies which are concerned with allied branches of the industry, and to the fact that although, as the Report of the Committee of the Privy Council states, the only university organisations for textile research are at Leeds and Manchester, a large volume of first-rate work is being and has already been done by the Cotton, Silk, Linen, and Woollen and Worsted Research Associations, as well as by academic and quasiacademic bodies such as the College of Technology at Belfast, the University College at Nottingham, the Imperial Institute, the Manchester Chamber of Commerce's Testing House, and the Conditioning House and Technical College at Bradford.

The British Association would have done a useful work if it had merely succeeded in focussing the attention of the academic and scientific world upon this matter. In directing attention to the fact that the fundamentals upon which the researcher in textiles has to work are just as indefinite, and at least as variable, as the fundamentals in any branch of science and technology with which the universities have been in the habit of intimately concerning themselves, it has, however, done much more. If, therefore, the meeting has succeeded in ensuring that textile teaching and research shall and ought properly to form an integral part of university and higher technological training, and no longer remain an almost despised Cinderella of subjects, it will have rendered a signal service to the industry and probably no less a service to the academic world.

No. 3029, Vol. 120]

<sup>1</sup> The British Research Association for the Woollen and Worsted Industries An Outline of its Activities. Leeds: Torringdon, Headingley. 1927.

Naturally the British Research Association for the Woollen and Worsted Industries, and its work, received considerable attention from the members of the British Association. This Research Association owes its inception and development partly to the Department of Scientific and Industrial Research, from which body it has received, in common with other research associations, very considerable monetary grants, and partly to the mitiative and enterprise of certain West Riding industrialists It has been guided in its development by a distinguished Council, over which Sir James Hinchliffe, a noted leader of advanced thought in the West Riding, has presided since its formation

The Research Association has, in common with the other bodies which have concerned themselves with textile research, had to consider problems in the two categories into which all research in connexion with the industry may be conveniently divided. It has considered the industrial or practical problems of the industry, and also the scientific principles underlying all the industrial operations. In order that the necessary experimental work might be carried out, it has established physical, chemical, and biological laboratories as well as machinery rooms in which manufacturing processes may be studied from an experimental point of view. The progress which has been made has necessarily been slow, though probably no less rapid than is usual with the development of theory in any other branch of science and technology. Its work, however, seems very clearly to have demonstrated two points; it has shown, first of all, that although the textile industry has been developed by what are sometimes described as unscientific men, yet their achievements have reached a remarkable standard of accuracy, and secondly, that spectacular development and invention is, very possibly, unlikely to take place in the future. Moreover, it has emphasised the vital fact that the gradual introduction of a special technologist capable of interpreting the thought and work of the investigators in pure and applied science is indispensable if the gulf which has so far existed between the industry and the field of genuine research is to be successfully bridged.

The nature of the fundamental problem which presents itself to the textile researcher may be appreciated by the consideration of the raw material of the industry, namely, the wool fibre. Examples of fibres (under the same magnification) of (a) Lincoln, (b) Merino, and (c) Crossbred wools are given in Fig. 1. These photomicrographs illustrate very clearly the variation in diameter and physical structure of three typical wools. It is evident that a complete knowledge of the wool fibre is essential and must ultimately become available, and that this knowledge will involve full information of the structure and physical and chemical properties of the fibre. Such information does not at present exist. In the industry the value of raw wool is, from a monetary as well as from a manufacturing

point of view, at present judged by what is called its 'quality' Quality is a term or number used to connote the probable spinning value of the wools (termed combing wools) employed in the worsted industry. Whilst it is true that experienced members of the worsted industry are able to gauge with remarkable accuracy the quality number or the counts to which a particular wool will spin, yet for this fundamental characteristic the industry has at present no definite measure. The quality of a fibre may, for example, depend on diameter, length, and elasticity, and each of these provides, in itself, a subject for research Important biological and physical problems must be considered in connexion with the length of the staple, while the elasticity involves a knowledge of the physical, and probably of the chemical, structure of the fibre

These matters are fundamental subjects of importance upon which the Woollen and Worsted

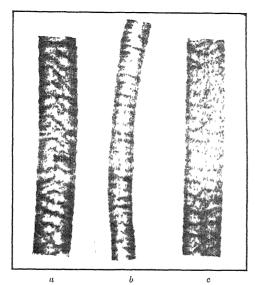


Fig. 1—Wool fibres.

a, Lincoln wool fibre, b, merino wool fibre; c, crossbred wool fibre

Research Association, as well as several other workers in textile technology, are now engaged. In "An Outline of its Activities," a recent publication of the Woollen and Worsted Research Association, the present position has been summarised. This report states, inter alia, that "at present there is an entire lack of definite knowledge on both points [the determination of the precise characteristics of and the best means of production of the raw material] regarding this raw material. The primary factor is to investigate those points regarding quality which may be expected to have a direct bearing on the economic value of the fleece."

Some of the chemical problems which have engaged the attention of the textile researcher are of special interest, indicating as they do the extent of the field for systematic research. The method of elimination of grease from raw wool by scouring with soap and alkali is being investigated. The soaps used may not, after scouring, be completely eliminated from the wool, and it appears that unless

the soaps are made from suitable fatty acids, other products are produced after scouring takes place, and these products materially affect subsequent processes, such as dyeing and finishing, to which the wool, in one form or another, is subjected. A preliminary examination appears to show that the absorption of alkali by wool may increase the susceptibility of the resulting cloth to bacterial action and may cause the dyeing affinity to vary from point to point of the cloth. The cause of this variation in distribution of the alkali after scouring is not merely mechanical but is undoubtedly related to alkali migration and to chemical action

Probably one of the most important aspects of the chemical work of the Research Association, a reference to which is made in the recent publication of the Association, is an investigation which it is conducting jointly with the Society of Dyers and Colourists. This investigation, which is being directed by a joint committee, will, it is understood, include initially fastness tests for sunlight, washing, and perspiration. The fastness tables which are already in existence do not give a definite fastness test to dyed materials, because the tests have so far been applied to single dyestuffs only. In practice, dveing by single dyestuffs is not usual The work which is now in process should thus enable the preparation of a complete standard for dved or coloured materials

One of the most interesting, though at the same time incomplete, investigations which has been made is the physical examination of the wool fibre The report of the Research Association states that "wool is an amphoteric colloid which in regard to physical and chemical relations presents the well-known colloidal characteristics." Dr. Shorter, in the Transactions of the Faraday Society, describes his attempts to develop a complete colloidal theory of the elasticity of the wool fibre In his theory he attributes "to the fibre the characteristics of a two-phase system consisting of an elastic frame-work (the elastic phase), the interstices of which contain a viscous medium (the viscous phase)" The elaboration and extension of such physical work must ultimately yield results of fundamental importance in so far as the primary formation of the fibre is concerned

Other investigations, though probably of no less fundamental significance but of immediate practical importance, are being made into the thermal conductivity of wool, its electrification and electrical conductivity, its elasticity, and especially into the effect of moisture upon it. The action of water upon wool is of immense practical importance, as it has a well-defined effect upon the combing, spinning, and manufacturing properties of the fibre, and depends to a very large extent upon the degree of moisture and the conditions under which the moisture reacts with the wool. It is, of course, well known that one of the reasons for the prosperity of the textile industry in Yorkshire and Lancashire is the dampness of the climate in those areas. This condition formerly made possible operations in those areas which could not be carried out as efficiently elsewhere The advent of systems of artificial humidification have, however, neutralised to some extent the natural advantages of the climates of those localities, and the work to which reference has already been made indicates that a complete knowledge of the mechanism of these actions is now within measurable distance.

The development of textile research would appear to deserve not only the attention which the British Association has properly given to it, but also the best which can be afforded by our academic and industrial bodies. Research is not, and should not be, the responsibility of one particular body. The research associations can do a great deal. The industries and the large academic bodies have also

an equally important duty to perform. The cooperation and sympathetic efforts of all these bodies should, however, ensure that textile research shall, under the favourable conditions which now exist, enter upon one of the most important stages in its development. Whitehead, in the preface to his "Principles of Natural Knowledge," points out that his inquiry "raises more difficulties than those which it professes to settle. This is inevitable in any philosophical work. . . . All that any one can hope to do is to settle the right sort of difficulties and to raise the right sort of ulterior questions, and thus accomplish one short step further into the unfathomable mystery." So it is with our textile researches

# The Germplasm and its Architecture.1

By Dr. F. A. E. CREW.

THE neo-Mendelian theory is like its parents a particulate theory, implying that the germplasm of organisms is not an indivisible whole but an organisation of units or factors which can be dissociated and recombined in various ways, just in the same manner as on the atomic theory a chemical compound is not a thing indivisible but an organisation of units which can be dissociated and recombined in other ways. But it differs from the theories that have gone before in that it is not purest speculation, incapable of confirmatory test; it is not merely an ad hoc explanation. It is not a preformatist doctrine, for no one ever seriously held that a factor was in any way a miniature replica or even was representative of a single character. The term unit character itself has been dropped, for it was misleading in view of the manifest fact that characters can never be units. The attitude of the geneticist in regard to the architecture of the germplasm is similar to that of the chemist in regard to the atomic constitution of matter. It is held that the hereditary constitution of an individual is not only composed of units in particular proportions and arrangement, but that its effects are determined by these proportions and by this arrangement just as much as by the particular nature of the units themselves. A character is the resultant of a large number of agencies of the internal environment of the zygote interacting with a large number of agencies of the external environment.

Weismann, in constructing his edifice of theory, with its purely hypothetical determinants, biophors, and ids, at least did one thing that must make his name immortal; he attached his speculations to something tangible by locating his units in the then newly investigated chromosomes. In this guess he enshrined the truth, for *Drosophila melanogaster*, in the hands of Morgan, Bridges, Sturtevant, Muller, and their colleagues, has provided definite and final proof that the chromosomes are indeed the germplasm, that upon each chromosome is borne a certain definite association of the hereditary factors or genes, and that each gene has its own particular place upon a particular chromosome. It has been

<sup>1</sup> Continued from p. 698.

possible in the case of Drosophila to construct a map of the chromosomes showing the relative position of all the genes so far discovered, and this map, like a railway time-table, giving the sequence of the places and the distance between them, in the hands of the breeder of this animal endows him with the powers of the synthetic chemist in the manipulation of his own material.

As yet, there exists but little exact knowledge of the chemical nature of chromatin: it is known, however, that it is intimately related to the activities of the cell as a whole, that it has a definite architecture and disposition within the nucleus; that during cell division it becomes condensed and homogeneous and then displays most clearly its organisation into units, the chromosomes. It is established that the number, size, form, and behaviour of the chromosomes are constant in a species and are characteristic of that species. It is known that even when the chromatin is thus condensed in the form of chromosomes, it still retains its organic contact with the non-chromatic part of the cell of which it is but a part, though an essential part: it is established that no development is possible at all in the absence of at least one haploid set of chromosomes. It has been amply demonstrated that the only identifiable cell organ which can satisfy the demands made upon the germplasm by the results of countless experiments are the chromosomes, and that in the behaviour of these are realised the precise conditions of hereditary transmission as recorded by observation.

The exact parallelism between the distribution of the chromosomes and the distribution of the hereditary characters affords an explanation of the ratios obtained in experiments involving freely assorting characters, if it is assumed that within the chromosomes are resident the genes, for the gene within the chromosome must necessarily go whither the chromosome passes. It is established that the chromosomes in the immature gamete and in the body cells generally are present in pairs, and that of each pair one member has been received from each parental organism. It has been demonstrated that in the ripe gamete only one member of each pair of

homologous chromosomes is present, and moreover, that the sorting of the chromosomes during the maturation of the gamete is at random, the distribution of one member of one pair being in no way influenced by that of either member of any other pair. It is not difficult, therefore, to explain the results of an experiment involving more than one pair of factors and giving free assortment and recombination, for all that must be postulated is that the different factor pairs are resident in different chromosome pairs.

The facts of linkage can be interpreted by postulating that the factors for linked characters are resident in one and the same chromosome, and that for this reason they must remain together in inheritance so long as the chromosome concerned retains The facts of crossing-over can be its integrity explained by postulating that the cause of this is an interchange of material between the members of a pair of homologous chromosomes, these chromosomes being dissimilar in their genetic constitution. It is frankly admitted that in this matter of crossingover genetics has outrun cytology, just as at one time cytology had outpaced genetics in regard to the mechanism of sex-determination, but the fact of crossing-over must not be confused with the validity or otherwise of the suggestion put forward to explain it. It is the case that during the maturation division in gametogenesis the segregation of homologous chromosomes is complicated by the fact that the members of each pair, prior to their separation, become most intimately intertwined. This apparently single, but really double, chromosome then splits longitudinally. This conjugation of homologous chromosomes provides the opportunity for crossing-over. It cannot be shown to have occurred, but if during this conjugation the two chromosomes stick, fracture, and rejoin before separation, then interchange of chromatin will have occurred. It is not without significance that conjugation occurs when the chromosomes are drawn out to their greatest attenuation, so that the homologous chromomeres derived from the two parents achieve the maximum degree of association in a linear series.

It is seen that the equivalent chromosome contributions of the two parents and their random assortment in maturation and chance recombination in fertilisation, together with the possibility of an inner reorganisation of each chromosome through its most intimate association with another of identical structure but different content, provide an infinite range of new combinations of character which can be tested out by environmental agencies. The chromosome mechanism can supply the variations upon which the forces of selection can operate. It becomes apparent also that this conjugation of chromosomes in synapsis excludes the possibility of fruitful crosses between species widely different in chromosome constitution.

If the conjugation of homologous chromosomes is accepted as evidence in support of the conception of crossing-over, and if the genes are strung like beads upon a string, each particular gene having its own particular locus upon a particular chromosome,

then it follows that the percentage of crossing-over between any two loci can be regarded as an indication of the distance between them. If the members of a pair of homologous chromosomes during their conjugation are as likely to fracture and reunite at one point as at any other point along their length, it follows that the farther apart any two genes lie in the chromosome, the greater is the chance of crossing-over occurring; and, conversely, the nearer together the genes lie, the smaller is the chance of crossing-over occurring If this is so, then it is possible to construct a map of the chromosomes, showing the relative positions of the different genes resident in each. If A, B, and C form a linear series, and if B has between A and C, then the crossing-over percentage occurring between A and C should equal the sum of the crossing-over between A and B,  $\hat{B}$  and C.

The conception of the localisation of the genes in linear alinement is due to the peculiar differences between the crossing-over between genes of the same character linkage group. The relation of three or more points to each other is a relation of linear order and cannot be represented in space in any other manner than by a series of points arranged in a line. Linearity is the expression of a system in which there is a fixed succession of elements. The distance between any two elements is constant but is variable throughout the series. In the case of the more simply organised forms of life it is possible to conceive the germplasm having the form of a congeries of chromatin units, the members of which can exist separately within the nucleus and become associated by chance. In the more complex forms, however, the precision exhibited in the inheritance of a most complicated characterisation demands a very precise and more complex hereditary mechanism, such as is supplied by the chromosomes in their constitution and behaviour.

The Columbia school has practically completed the essentials of the static theory of heredity concerning the existence and distribution of genetic units initiated by Mendel. The germplasm has been identified and its architecture defined. The chromatin material of the nucleus of the cell is the germplasm and the hereditary units are the genes. A gene is a particular state of organisation of the chromatin at a particular point along the length of a particular chromosome. It is a particular area or locus of the chromosome in a particular state. One particular condition of this chromatin can be replaced by others and with each change another gene appears.

The Columbia school has, however, done more: it has initiated a dynamic theory concerning the relation of these genetic units to development. Bridges, out of his magnificent work on balanced intersexuality in Drosophila, was able to lay the foundations of the fundamental theory of genic balance, according to which the effect of a gene depends not only upon environmental conditions but also and particularly upon the other genes with which it is associated in the hereditary constitution of the individual. Bridges has proven up to the hilt that the sex-chromosomes exert their effects

not per se but only when in a certain relation with other chromosomes. Further, it has been shown that the subtraction or addition of whole chromosomes or of whole sets of chromosomes, as in haploid or polyploid individuals, is associated with constant and definite variations in characterisation. This observation, first made by Gates, has been extended, for example, by Bridges to Drosophila, by Wettstein to mosses, and by Blakeslee to Datura

It is an obvious fact that the extent of our knowledge of the genetics of a particular form is determined by the frequency of mutation in that form. So much is known of Drosophila, because, amongst other things, observed mutation in this form is relatively common. The gene is stable and so far has resisted most attempts to modify it experimentally. It will be recognised that if the usual genetical methods of investigation are to be used, then in the case of an animal or plant of economic importance in which mutation is rare, there can be no rapid increase in our knowledge of the genetics of this form until it has become possible to provoke mutation at will. It has been reported repeatedly that germinal changes, presumably mutational, had been induced by X-rays, radium, alcohol, lead, antibodies, and so forth, but the interpretation of the data thus secured has been highly disputatious. It is known that X-rays can and do affect the distributive mechanism of the chromosomes and the phenomenon of linkage, and it is now reported by Muller that radiations of short wave-length can produce gene mutations in a high proportion of germ cells so treated. Mutations thus produced are stable in their inheritance and behave in a manner typical of Mendelian chromosomal mutant genes found in organisms generally. Such treatment produces an increase of about 15,000 per cent. in the mutation rate of the stock. Many of the mutations invoked are those which have previously appeared in Drosophila; many, on the other hand, are mutations in loci, in which mutation apparently has never been observed

Through the use of appropriate doses of X-rays |

also it has been found to be possible to provoke a high proportion of rearrangements in the linear order of the genes associated with fragmentations and translocation of portions of a chromosome. Here, lying now m our hands, is the very tool wherewith to explore the hereditary constitution of animals and plants of interest and of economic importance No longer must we wait for mutations to occur · no longer need we squabble amongst ourselves concerning the rôle of external agencies in the provocation of mutation, for it is demonstrated that it is possible in our chosen experimental stocks to manufacture series of artificial strains for use in the study of genetic and phænogenetic phenomena It may soon be possible to produce to order sufficient mutations to furnish adequate chromosome maps, and thereby to give to the breeder of domesticated stock the powers of control that he must have to be ultimately successful. There is no reason to assume that X-rays alone will do this thing: doubtless there are plentiful agencies, chemical and physical, which appropriately exhibited will do the same.

Advances in genetics in the more immediate future will be in the borderland of formal genetics and of developmental physiology. They will result from the deliberate and artificial induction of mutation and from the study of the gene in action. In this latter field the trail has been blazed by Goldschmidt and by Haecker Drosophila has served its purpose magnificently, but the time now approaches when other animals will usurp the centre of the genetic stage; experimentation will become more laborious, since each gene will have to be examined for the kind and rate of change which it produces. Geneticists, hearing of the vem discovered by Mendel, rushed headlong to this new Klondyke, avid for the gold of truth. They are now returning, some empty-handed, but many with nuggets of great worth. It will be well for biological science if those who resisted the call and stayed dutifully behind deny themselves the simple amusement of taunting the wanderer until at least they have assured themselves that nomadism of this kind must necessarily be profitless.

# Rationalisation in Industry.

FOR many reasons the introduction of scientific research into the old-established industries of Great Britain as an aid to production is a lengthy and difficult process. Much progress, however, has been made in recent years, notably with the aid of co-operative research associations, but much more remains to be done. The degree of interest in research shown by industries is a matter of concern to every scientific man, for an increasing appreciation of the potential industrial value of research spells more practical interest in the work of universities and similar institutions where pioneering investigations are carried out, and m-creased outlet for scientific employment.

How confidence can best be fostered is a matter of concern to many, and various ways have been tested or considered. Research is slow to fructify,

and industrial research may be especially so when the objective is restricted and definite. While broad researches are maturing the interest of the manufacturer may wane unless he have the stimulus of some accessory assistance. The successful solution by scientific research of a simple technical problem may be as convincing to a manufacturer as a far-reaching investigation of, say, the properties of his raw materials, necessary though that investigation may be. The simple problems cannot be ignored. Similarly, the demonstration of the utility of existing information is a valuable aid. There is much scope in industry for the increased utilisation of current information, scientific or otherwise, and valuable propaganda work can be accomplished by the organised collection and distribution of such information. In

this connexion a group of papers relating to information, organisation, and statistics in commerce and industry, discussed at the recent conference in Cambridge of the Association of Special Libraries and Information Bureaux, is of direct interest

The first paper in the group, dealing with rationalisation in industry, was communicated by Major L Urwick, honorary secretary of the Management Research Groups. The basic idea of the rationalisation movement is 'control' in the sense of "the detailed analysis and measured presentation of the facts in each and every set of circumstances—and the planning and organisation of future common action in the light of those facts " The movement is, in reality, an endeavour to develop the scientific habit of thought within industry and commerce. It insists that the phenomena influencing the course of business have each their cause, that the causes are capable of investigation and definition in the light of modern knowledge, and that the facts so gathered can advantageously be applied to the effective solution of fresh problems. Such an outlook must, as Major Urwick points out, be rationally applied to a manufacturing concern as a whole. It is useless, for example, to attempt to improve output by motion study among the operatives until the management, organisation, and planning of the concern as a whole have been put upon a sound basis; in the smaller industries, labour is often more conscious of mefficiencies than The objective should be a wellis management planned structure, strong, efficient, and co-ordinated in all its activities, and ever alert for improvement

In Great Britain the movement has recently found an outlet in the formation of the Management Research Groups. Co-operation is essential to the success of the movement, which calls for the free exchange of experience and facts bearing upon every aspect of industry. Each of the groups is a small band of representatives of manufacturing concerns in different industries. No two competing firms are represented in the same group, a compromise which meets the still existent feeling in favour of secrecy in industry. The firms in any group can investigate and discuss the best practice in each individual concern without fear of giving advantage to a trade rival. Major Urwick's survey of the need and scope for rationalisation in industry was of such great interest that it was to be regretted that time did not permit him to give a more detailed account of the progress of the Management Research Groups with which he is associated.

In the course of his paper, Major Urwick directed attention to the need for more and better coordinated statistics, in a later paper, Mr. A. E Overton, of the Board of Trade, described the trade information and statistics in Great Britain as compared with those in other countries manufacturers and traders are probably not fully aware of the sources of statistical information that are available, and to these Mr. Overton's paper will be of value reference is made to the time-lag in the issue of the statistical information from the various sources and the degree of classification adopted. Statistics of external trade and of internal production are of course of prime necessity in business forecasting, a subject discussed in the paper by Mr. W. Wallace. This paper outlines and illustrates the conclusions of the Harvard Committee on Economic Research; incidentally, it gives due weight to the limitations of business forecasting m its present pioneer stage. The paper by Mr. S. J Nightingale and Miss A. L Bennie dealing with statistical analyses in the engineering industry gives illustrative examples of the analysis of the available information in the formation of a sales A further example of the use of statistics in an industry was given by Mr. F. W. Tattersall, who discussed the relation of cotton statistics to marketing and market estimation, and the group of related papers was completed by Mr F. Hall's account of the more general aspects of the trade

At first sight the interest of such papers for a conference of the Association of Special Libraries and Information Bureaux is not obvious. The collation of sources of information, which is the chief function of the Association, should, however, render the latter almost essential to the rationalisation movement. The Directory of Sources of Specialised Information which the Association is shortly to publish will be of the greatest assistance to those who have to collect and collate the facts that industry needs. As an organisation for ascertaining and indicating where information is to be found, the Association should play a not insignificant part in the movement.

The movement deserves at least the benevolent interest of the scientific worker. It awakens in mdustry the scientific habit of thought; it encourages the wider dissemination of knowledge, including scientific fact, it fosters an increasing interest in, and appreciation of, science; if successful, it cannot fail to stimulate the utilisation of scientific research in industry.

# Obituary

Dr. D. G. Hogarth, CM.G.

BY the unexpected death of Dr. David George Hogarth on Nov. 6, geography and archæology lose one of their most distinguished representatives in Great Britain, and the University of Oxford one who combined in an unusual way the qualities of a student and a man of action and affairs. Born on May 23, 1862, at Barton-on-Humber, he was admitted commoner of Winchester in 1876, and elected to a classical demyship at Magdalen College, Oxford, in 1881, where he was placed in the first class in Honour Moderations and Literæ Humaniores, appointed to a classical lectureship, and then m 1886 elected to a fellowship. Both at school and at college he distinguished himself as a runner, and made himself felt in the social life of the place, presiding over the Junior Common Room, acting with the O.U. Dramatic Society, and editing the Oxford Magazine Of these early days he has left his own frank account in one of his most characteristic books, "Accidents of an

Antiquary's Life "

It was, indeed, a group of accidents that determined Hogarth's career The Craven Travelling Fellowship, of which he was the first holder in 1886, was itself an experiment in classical endowment, though the benefaction was an old one The new Lincoln and Merton professorship in classical archæology and art was maugurated in 1885 by Dr. (now Sir) W. M. Ramsay, who had begun m 1880 those journeys which revolutionised our knowledge of ancient Asia Minor had already been attracted by the historical and geographical achievements of Alexander the Great, and was collecting materials for his "Philip and Alexander," though this was not published until 1897. He seized the opportunity of apprenticeship to field work with Ramsay; and so began a partnership in research, all the more fruitful because the qualities of the two men supplemented each other. As one of the first students at the newly founded British School of Archæology at Athens, he took a leading part in excavating the famous Temple of the Paphian goddess in Cyprus. First fruits of this adventure and of an extensive tour in unfrequented parts of the island were published m 1890 under the title of "Devia Cypria" In Cyprus, then, and Asia Minor, he began that intimate acquaintance with the peoples and problems of the Near East which led him afterwards to Deir-el-Bahari, Naukratis, and Carchemish, to North Arabia, and the 'Arab Bureau' in Cairo.

To combine these vacation pursuits with the routine of a college dean and vice-president was not easy. "Philip and Alexander" had to await the convenience of Turks and undergraduates; but with wise economy of resources Magdalen created a research fellowship, and made Hogarth master of his time and movements, with an Oxford home in which to store and work up his materials. Fortunate again in his opportunities, he was Director of the British School at Athens, and in charge of excavation on the prehistoric site at Phylakopi in Melos, during the years when Crete fell free of Turkish rule and excavation became possible there; and in the early years of Sir Arthur Evans's great enterprise at Cnossus, Hogarth was engaged in opening tombs hard by, and in exploring the important and difficult 'Cave of Zeus' on Mt. Dicta, and the remote but significant site at Zakro, looking out over the ancient sea route to Egypt. Emergency work at Naukratis, rendered necessary by the extension of irrigated land in the Delta, took him in 1899 and 1903 to Egypt, where he had already excavated at Deir-el-Bahari in 1894, at Alexandria in 1895, and in the Fayum in 1896. Then came the British Museum's excavation of the Temple of Artemis at Ephesus in 1904-5, with unforeseen difficulties from flood and fever, and no less unforeseen results in the splendid foundationdeposit of early goldwork and ivories, throwing quite new light on early Ionian art and culture. These were published in a stately memoir in 1908,

and interpreted in larger historical perspective in "Ionia and the East" in 1909 After another season in Egypt, at Assiut, came another chance to break fresh ground, at Carchemish on the Euphrates, again for the British Museum, with assistants of his own training, T. E Lawrence and C. L Woolley, both destined to notable achievements later

Meanwhile a fresh line of work opened in 1909, when Sir Arthur Evans resigned the keepership of the Ashmolean Museum, which he had re-created as a centre of prehistoric and oriental studies. Hogarth was the obvious man to succeed him, and the peculiar combination of facilities for home study and field work which the keepership offers, happily provided for him the post which he held until his untimely death. He retained his Magdalen fellowship, and took an ever-increasing part in University affairs, on the Hebdomadal Council, the Clarendon Press, and (later) the Statutory Commission; and it was at one time hoped that he might represent the University in Parliament.

Across these many activities, and still more across his archæological work, broke the Great War. Hogarth had intimate knowledge of Turkish and Arab ways, and was able to render most valuable services in organising and directing that 'Arab Bureau' in Cairo which prepared the way for attacking the Ottoman Empire at its weakest point, through that 'Revolt in the Desert,' in which T. E. Lawrence was his own discovery. At the Peace Conference he represented Great Britain in the Middle East Commission, and maintained the keenest personal interest in the new regime and its problems. For these public services he was honoured with the C.M.G., and Egyptian and Arab decorations. His wide and detailed knowledge of Arabia and the neighbouring lands was recognised already by the award of the Founder's Medal of the Royal Geographical Society, and assured his election as president of that Society in 1925.

With these numerous calls upon his time and great abilities, Hogarth's output of scientific work was less abundant and consecutive than those who best knew his fine scholarship, wide learning, and literary facility, had reason to expect he neglected the prompt and detailed publication of his numerous pieces of field work and excavation —though this was not the side of the business that best pleased him. But, naturally laconic, and clear-headed, he wrote concisely, and without parade of information, beyond what was essential to his point. He had, moreover, a journalistic—or was it rather Herodotean—appreciation of episodes and situations, vividly revealing "all the kingdoms of the world in a moment of time," and some of his best remembered writing deals with incidents of this kind. But for a man of these wide interests "the world is so full of a number of things," that a lifetime passes all too soon, in 'Forschungen' and 'Prolegomena,' not to mention the "History of the Air Force," which he inherited from his friend Sir Walter Raleigh, and a projected life of 'Arabian' Doughty, another of his heroes. "Alexander" seemed always to have to wait.
What will be remembered, however, besides

Hogarth's brilliant summaries of geographical and historical knowledge, "The Nearer East," "The Penetration of Arabia," "The Ancient East," and The Balkans," is his monumental catalogue of the "Hittite Seals" of the Ashmolean Museum (1922), and the numerous short articles which announced, interpreted, and thereby in a very real sense guided the progress of discovery in the difficult history and ethnography of Asia Minor and North Syria. Though he never brought his materials together into a general survey—for which, indeed, the time is scarcely yet come—this group of problems was

that to which his mind seemed most spontaneously to recur; to which he gave all time spared from the more urgent 'accidents' which beset a 'wandering scholar', on which his judgment was most in demand among colleagues who had not his distractions and occasions. Had he entered the army (as at one time he desired), Hogarth might have been a great commander, for he could handle men, and his decisions were those of a 'cavalry-mind.' In his actual career he was a superb scout, with a general's outlook over the prospects and trend of exploration J. L. M.

# News and Views.

The appearance of Prof C. T. R. Wilson's name in the list of Nobel prize winners for 1927 will be received with acclamation by physicists throughout the world. The polished perfection of his experimental work and the subtle ingenuity of his methods have long been the admiration and the despair of workers in the same or in cognate fields Prof. Wilson is, perhaps, best known for his experiments on the tracks of ionising particles in gases, work which has occupied him, at intervals, from the time when he joined the first group of research students under Sir J. J. Thomson, some thirty years ago. His discovery that gaseous ions would serve as nuclei for the deposition of water drops was the basis of the first methods of measuring the charge on an electron. With definite patience and resource, the technique of these early experiments has been gradually perfected, until now it is possible to make visible, and to photograph, the actual tracks of ionising particles, to count their number, and to watch every twist and turn in their paths. The power of rendering visible, at will, the actual paths of particles which, themselves, must remain for ever invisible is a weapon of no small value in investigating the behaviour of these particles, and Prot. Wilson's apparatus is being employed more and more in our great research laboratories, almost always with striking and important success. Prof. Wilson, however, is not known only by his work on 'tracks.' He is one of our foremost experts on atmospheric electricity; and it would be both unfair and ungrateful not to recall in conclusion his 'tilted' electroscope, a measuring device which made possible much of the early work on ionisation in gases.

Prof Arthur Compton, of Chicago, who divides with Prof. Wilson the Nobel prize for physics for 1927, belongs to the younger school of American physicists, and has distinguished himself by the daring originality of his speculations, as well as by the variety and ingenuity of his experiments. Adopting the new 'quantum' theory in its most extreme form, he was able to calculate the change in wave length which should occur when X-rays are scattered, and by very able experimental work to obtain confirmation of his calculations. The technique of these experiments was so difficult that it was some time before the results were confirmed by other workers, and some controversy arose as to the genuineness of the effect. In the

end, however, the Compton effect was finally established, and it stands to-day as the firmest individual piece of evidence in favour of the hypothesis of localised light quanta.

THE recent judgment of the Court of Appeal in Inland Revenue Commissioners v. Yorkshire Agricultural Society, before the Master of the Rolls, Lord Justice Atkin, and Lord Justice Lawrence, is significant as indicating the confusion and difficulty prevailing in interpreting what is or what is not a 'charity within the meaning of the Income Tax Acts. The Commissioners had refused the claim of the Society to exemption, whilst on appeal to the Special Commissioners the claim was allowed. Mr Justice Rowlatt in the High Court afterwards reversed the decision of the Special Commissioners; and now the Court of Appeal unanimously affirms the Special Commissioners' decision. In giving judgment for the Society the Master of the Rolls referred at length to the objects for which the Society was established, pointing out that it was formed at York in 1837 for the purpose of holding an annual meeting for the exhibition of farming stock and implements, etc., and for the general promotion of agriculture. Prizes were awarded, and the members enjoyed certain privileges and benefits. The privileges and benefits which the members derived did not, in his loidship's opinion, in any way detract from the fact that the purpose of the Society was charitable within the meaning of the Act, any more than the privileges and benefits which subscribers to other charities, such as hospitals, derived, altered the fact that they were charities. He held that this Society, which by its constitution in 1837 and since had continued for the purpose of the general improvement of agriculture and not merely for the special benefit of its members, was in fact a society for the general benefit of the community, and therefore came within the accepted definition of a charity as laid down by Lord Macnaghten (Income Tax Commissioners v. Pemsel, 1891). This decision should help to define the position of scientific societies in regard to exemption from income tax, for they should be able to establish, by their constitution and the aims and objects of their work, those elements of permanency and benefit to the community that the Yorkshire Society has claimed and won for agricul-

Prof. W A Bone's researches on high-pressure gaseous combustion which, with the collaboration of assistants, have been carried on since 1920 at the Imperial College of Science and Technology, London, have become so well known, and have so direct a bearing on new developments in chemical industry, that the extension of the work and the occurrence of greater opportunities for training in its special technique will arouse more than local interest. A generous donation and annual grant by Imperial Chemical Industries, Ltd., together with increased assistance from the Department of Scientific and Industrial Research, have supplemented the funds already supporting the investigations, making possible the equipment of two new high-pressure gas research laboratories, including an experimental gas-generator plant, gas-holders ranging in capacity from 10 to 3000 cubic feet, and compressors The explosion bombs will be capable of withstanding pressures ranging from 100 to 20,000 atmospheres, respectively, and the catalytic-tube units will withstand 500 atmospheres at 500° C. By the end of March 1928, most of the new equipment will, it is expected, be ready for operation, and a limited number of selected postgraduate research students (early application regarding the vacancies being advised) will be accepted for systematic training over a period which will usually be not less than two years. The staff will consist of four research assistants, an instructional assistant, and a mechanical assistant; the work will be directed by Prof. Bone, assisted by Dr D. M. Newitt and Dr. D T. A. Townend, and by Mr W. E Stockings.

A DISPATCH from the Cairo correspondent of the Times which appeared in the issue of Nov 9 describes some of the results obtained by the excavations at Sakkarah, where work has now been resumed for the season. The excavations, which began in 1923, are being carried out under the direction of Mr. Cecil Firth for the Egyptian Department of Antiquities. They have opened up an entirely new chapter in the history of Egyptian art and architecture, and may be expected to lead to even more important results in the near future. In carrying on the clearing of the Temenos surrounding the Step Pyramid, which was begun in 1926, it was discovered that at one point where the Temenos wall was higher it formed the superstructure of a tomb which proved to be of the III Dynasty, and must have belonged to a member of the Royal family or an important personage of the court. Access was obtained to the tomb after immense labour by means of a plunderer's shaft in the rubble and giving access to a rectangular space cut in the rock, and a stairway leading at a distance of twenty yards to a doorway beyond which the stairway continued. This passage, after passing two sets of chambers, eventually reached one of the most extraordinary funeral apartments ever found. So far as explored it has two rooms which were entirely lined with blue tiles. In one room, three doors each had exquisite reliefs of King Zoser wearing the red or white crown. The tiles were arranged to give the impression that the rooms were lined with reed mats, placed vertically, except over the panels of the doors and the drums over the doorways where they are horizontal, and give the appearance that the mats are rolled up to reveal the rehefs. A series of passages behind leads to a pit filled with debris, upon which work is now being concentrated.

Cod-Liver oil has for long been considered the most potent source of the two fat soluble vitainins A and D. but, though palatable to some, to others it possesses an unpleasant flavour which is only imperfectly disguised even when the oil is mixed with The discovery by Rosenheim, extract of malt Webster, and Windaus (Lancet, 1927, vol 1 p. 306, and NATURE, Sept 24, p. 440) that the parent substance of vitamin D (the antirachitic vitamin), from which it is formed by the action of ultra-violet light, is ergosterol or a highly unsaturated sterol of similar constitution, opened the way to the production of this vitamin on a large scale, under controlled conditions, and without the necessity of using codliver oil at any stage, since the ergosterol can be obtained either from ergot or yeast as a pure chemical compound. Although vitamin D is specific in its effect in ensuring proper calcification, its absence from the diet leading to the development of rickets, yet in its influence on growth it is associated with vitamin A: the latter is probably of the greater importance in this connexion, but its full effect in producing growth in the young animal is not observed unless vitamin D is also present. For this reason vitamin D alone would be of less general use than if accompanied by vitamin A.

THE British Drug Houses, Ltd., London, N 1. have taken advantage of the recent advances m our knowledge of the vitamins to put up preparations containing vitamins A and D obtained from sources not previously utilised. Vitamin D is made by the irradiation of ergosterol, and is issued under the name 'Radiostol' in solution as a sweetment pellet. Vitamin A is contained in an oil not previously used as an accessory food: it is issued, combined with vitamin D, as an oil called 'Radiostoleum.' The latter is also issued as an emulsion, 'Radiomulsin,' and as an emulsion with malt, 'Radio-Malt,' in which the malt extract provides also a supply of vitamin B. The vitamin content in these different preparations is controlled by physiological feeding tests on animals, and is higher than in cod-liver oil and its various preparations.

The Slutzk, better known under its original title, Pavlovsk, Observatory for meteorology and geophysics, will celebrate on Dec. 4 the fiftieth anniversary of its foundation. Well equipped with magnetic instruments designed by its eminent first director, H. Wild, and for many years the most northern magnetic observatory in the world, Pavlovsk has supplied a long series of valuable magnetic results, which have been utilised in many researches by foreigners as well as Russians. Observations in atmospheric electricity, begun in 1913, have supplied data of much interest in connexion with the vexed question of the true nature

of the durnal variation of the potential gradient Actinometry has also had a special place in the programme of the observatory during the present century Aerological work in Russia had its origin at Pavlovsk some thirty years ago, but it is now provided for in a separate institution. Foreign participation is invited in the approaching ceremony.

An interesting biographical sketch, by Mr Rollo Appleyard, of Heinrich Hertz, one of the greatest pioneers on the transmission of electrical waves, appears in the October number of Electrical Communication. At the age of twenty-three years, Hertz was elected a demonstrator in physics by Helmholtz Three years later he became a lecturer in theoretical physics in the University of Kiel. After two years at Kiel he became professor of experimental physics at Karlsruhe, and finally he was appointed to succeed Clausius as professor of physics in the University of Bonn. His wonderful experiments on the reflection, refraction, and polarisation of electric waves created intense interest at the time and opened a new field of research. They form the foundation on which most of present-day developments on radio communication are based. The author gives photographs of Hertz's original apparatus and of the devices he employed to produce and to detect the electric waves. He points out how nearly Hertz and his colleague Lenard anticipated the discovery of Rontgen rays. Hertz himself thought it unlikely that electric waves through space could be used for communication He died at the early age of thirty-seven. Those who knew him best remember him as a singularly modest man, one who seldom spoke of his own discoveries and never mentioned himself. When the Royal Society presented him with the Rumford medal, he silently disappeared from Bonn for a few days, giving no reason for his absence. He studied pure science exclusively, and yet the importance of his discoveries in the advancement of the practical applications of electricity is beyond measure.

Opinions may differ about the ethics of greyhound race-courses, but it seems likely that this form of sport will become as popular in Great Britain as it has already become in the United States. In the Metropolitan-Vichers Gazette for October, a good account is given of the electrical equipment of a greyhound racecourse. All around the course, which is 500 yards long, a sunken trackway is constructed in which a narrow-gauge railway is laid. The trackway is covered, but an opening in the woodwork is left on the side nearest the course. Through this opening an arm projects which carries an artificial hare. The arm forms the axle of a rubber-tyred wheel above which is the hare. It is attached to an electrically-propelled truck which collects the electric current from a third rail and returns it by the ordinary rails. Special precautions have to be taken to avoid sparking, which might disturb the dogs. Acceleration and deceleration have to be very rapid and high power is therefore necessary. The running of the truck is controlled by a single operator from a control tower observation room, so situated that a full view of the racing can be had at all times. Speeds up to 50 miles per hour are obtained, and the hare must be capable of being accelerated at a rate of not less than 2.5 miles per hour per second. When a race takes place the hare is run round the track, and immediately it has passed the boxes where the greyhounds are confined, the gate is thrown open and the dogs dash out in pursuit. The attendant keeps the hare ahead of them until the circuit is complete and then switches the truck into a siding. This causes the hare to disappear and the dogs cease to run. The Company mentions ten large towns in Great Britain for which it has supplied or is supplying the electrical equipment for the tracks.

In order to lower the price of electricity it is necessary to have all the machines in a power station running for as long a period as possible. To enable this to be done it is advisable that engineers should encourage a night load on their stations. One way of doing this is to store up energy in consumer's houses during the night time which can be utilised during the day. One of the best ways of doing this is to heat water slowly during the night by electricity, the warm water being utilised during the day. This is already done on a large scale in several places in Great Britain and abroad In Basle there is a thriving industry in making electric water heaters and time switches. These heaters work only between 10 P.M. and 6 A.M., the switching being done automatically The results obtained prove that this domestic storage is a boon to the consumer and is profitable to the electric supply company. The Glasgow Corporation is also encouraging domestic storage. Electricity is supplied for this purpose at the very low rate of 3ths of a penny per unit. The heat losses from a well-designed electric heater are so small that the consumer is scarcely affected by them In another system, used abroad, each room of the house contains a 'heat-accumulation' stove. Each stove contains steatite blocks of high specific heat which are heated by cheap night energy. When taking energy during the night a damper at the top of the stove is kept closed. In the morning, or whenever necessary, this is opened and convection currents circulating upwards heat the room. Another system of storage heating for large buildings is to have heating elements embedded in concrete floors. A full description of these and other methods is given by L. G. A. Sims in a series of articles in the Electrical Review, beginning in the issue for Oct. 21.

In travelling about the country, especially, but not entirely, in out-of-the-way fishery districts, fishery enthusiasts, both amateur and professional, are frequently met with, demanding information on fishery problems, whether these relate to fish in a zoological sense, or 'shellfish.' The Fisheries Branch of the Ministry of Agriculture and Fisheries is now making efforts to form what is, in effect, a British Fisheries Information Bureau in embryo, by supplying information (free on application to the Fisheries Secretary, 43 Parliament Street, London) in a series of numbered Fisheries Notices, which are small pamphlets dealing in a popular manner with fishery

problems on the biology and or economic aspects of particular freshwater and marine fish and 'shellfish.' There remains, however, a lot of ground to be covered before the Fisheries Branch can be regarded as having supplied inquiring fishery interests, with not only that which is known, but also in many cases that which is not known, and the department concerned may reasonably be urged to speed up its work So far the subjects dealt with are, respectively: No 3, Precautions re installing motor power in fishing vessels; No. 4, Value of the herring as good; No 5, Instructions for taking water samples in cases of pollution of fisheries; No 6, Particulars of publications about all fishery matters; No. 7, Instructions for cooking salted herrings, No. 8, Methods of preparing and cooking freshwater fish; No. 9, On the capture of freshwater eels; No 10, About the marking of fish; No. 11, On sheep-dips and sheepdipping; No. 12, The life-history of the place; No. 13, Mussel cultivation; and No. 14, Cockle culture.

Fisheries Notices, No. 13 and No. 14, are new, and both contain interesting and informative short chapters on natural history, methods of fishing, cultivation, destructive influences and animal foes and parasites, economic uses, and also-a subject on which the Ministry can speak with authority—on pollution and purification. In both cases the account of the natural history would have been improved if it had been explained that, in spawning, the eggs are shot out of the shell, and not retained as they are in the English oyster (O. edulis) and some freshwater pearl mussels (e.g. Anodonta). Similarly, in the chapters on cultivation, the practical value of simply transplanting young individuals from situations high up in the tidal zone to lower ones, chosen with circumspection, might have been stressed to greater advantage. The mussel and cockle are, however, of relatively small value compared with the oyster, lobster, crayfish (Palinurus), and the various dog-fishes, about all of which the dissemination of information would be of undoubted economic value to many interested in fisheries. It is to be hoped that the Fisheries Branch has in view the issue of additional pamphlets on these subjects in the near future.

Though the problem of providing adequate indexes to scientific and learned books and journals is ever to the fore and is constantly engaging the attention of the various professional bodies concerned, the old idea that indexing is essentially the work of the unskilled drudge has not been entirely eradicated. It is now proposed to form an Institute of Indexing, the main objects of which will be to encourage the compilation of efficient indexes to books, periodicals, and other literary works and papers, and to promote their intelligent use by the public, to maintain a register of qualified indexers, and generally to give advice and assistance wherever needed. It is not apparently intended that the Institute should follow in the footsteps of the old Index Society and devote itself to the actual compilation of indexes, but that primarily it should act as a trade union to represent qualified indexers in all matters affecting their status and recognition as members of a 'key' profession. The organisers are ambitious enough to hope that there will be a grade of 'fellows' confined to fully qualified indexers, and one of ordinary members for those interested from the users' point of view or who wish to avail themselves of the advisory and other services of the Institute Particulars may be obtained from Mr. W. R. Douglas Shaw, "Beautort," Mornington Road, Chingford, London, E.4.

PROF. W. A BONE will deliver a lecture entitled "Gaseous Combustion at High Pressures," in the rooms of the Chemical Society, Burlington House, on Thursday, Nov. 24, at 8 P M

SIR ARTHUR KEITH, president of the British Association, will take the chair at the third annual Norman Lockyer lecture, "Scientific Ethics," to be delivered by the Very Rev Dean Inge, in the Goldsmiths' Hall on Monday, Nov. 21, at 4 P.M

PROF E. T. WHITTAKER will deliver a lecture at the meeting of the London Mathematical Society on Thursday, Dec. 15, at 5 p.m., in the rooms of the Royal Astronomical Society, Burlington House. His subject will be "The Influence of Gravitation on Electromagnetic Phenomena." Members of other scientific societies are invited to attend.

The maugural meeting of the British Institute of Radiology, with which the Rontgen Society is now incorporated, is being held on Nov. 17 and 18, and is the first meeting of the reconstituted body. The meeting thus marks the commencement of a new era in the history of radiological organisation in Great Britain.

Three earthquakes of moderate intensity were recorded at Kew Observatory on Nov 14. The times of arrival of the first phases were 0 hr. 21 min 25 sec., 5 hr 5 min 49 sec., and 7 hr. 33 min 21 sec G M.T. The second earthquake was a repetition of the first, and the epicentre is estimated to have been 3680 miles away, probably in the Arctic Ocean. The epicentre of the third disturbance was at a distance of about 6300 miles.

The following officers and new members of council of the London Mathematical Society were elected at annual general meeting held on Nov. 10: President: Prof. G. H. Hardy; Vice-Presidents: Prof. A. S Eddington, Mr. R. H. Fowler, Prof. G. B. Jeffery, Treasurer. Dr. A. E. Western; Librarian: Prof. H. Hilton; Secretaries: Prof. G. N. Watson, Mr. F. P. White; New Members of Council: Prof. P. J. Daniell, Mr. A. E. Ingham, Dr. E. G. C Poole.

APPLICATIONS for grants from the Chemical Society Research Fund must be received, on a prescribed form, by the Assistant Secretary of the Society, Burlington House, W.I, not later than Dec. 1. The income arising from the donation of the Goldsmiths' Company is more or less especially devoted to the encouragement of research in morganic and metallurgical chemistry. The income from the Perkin Memorial Fund is applied to investigations relating to problems connected with the coal-tar and allied industries.

MESSRS. J. and A. Churchill, the well-known firm of medical and scientific publishers, have removed from Great Marlborough Street to 39 and 40 Gloucester Place, Portman Square, London, W.1. The firm was founded in 1825 by the grandfather of the present partners, the late John Churchill, and since 1845 it has published "The Medical Directory." Its list of authors includes leading representatives of many departments of science.

WE have received from Mr. W. H. Harling, 117 Moorgate, London, E.C.2, copies of two recent sectional catalogues of drawing instruments, most of which are manufactured by the firm at the Grosvenor Works, Mount Pleasant Hill, London, E.5. Catalogue No. 5c deals with compasses, dividers, and similar instruments, both singly and in sets. The 'British Empire' (B.E.) series of instruments are made of hard-drawn electrum and fitted with stainless steel ink points; the compasses are provided with self-centring head-joints. Catalogue 8b is devoted to drawing scales and boards, T-squares, etc.;

it includes particulars of slide-rules, planimeters, and integrators of special patterns, as well as instruments made by the firm.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned .- Fulltime teachers of carpentry and joinery, carving and modelling, and of pharmacy, in the Leicester Colleges of Art and Technology-The Registrar, Colleges of Art and Tethnology, Leicester (Nov. 30). A senior lecturer in the department of pure and applied science of Loughborough College-The Principal, Loughborough College, Leicestershire (Dec. 1). A mathematical master at the Royal Naval College, Dartmouth —The Headmaster, Royal Naval College, Dartmouth (Dec. 15). An officer with experience of plantation work to take charge of the Oil Palm Plantation of the Government of Sierra Leone—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1. A head of the Arts department of the Portsmouth Municipal College—The Secretary, Office for Higher Education, Municipal College, Portsmouth.

### Our Astronomical Column.

THE TRANSIT OF MERCURY.—Fine weather favoured this phenomenon in most parts of England, and a large number of observers made successful observations The planet appeared as a well-defined black spot, decidedly darker than any of the umbræ of the large sunspot group that was nearly central on the disc No trace was seen of any luminous ring round the portion of the disc that had passed off the sum at egress Definition was not very good owing to the low altitude; consequently there is a range of many seconds in the times of contact given by different observers It is most convenient to give the times as corrections to the predicted times, which were 8h 28m 23s 9 for third contact, and 8h 30m 5s 2 for fourth contact for London and neighbourhood. Mr. L. G. Guest, observing with an 8½-inch refractor at Ferring, Sussex, found the corrections - 25<sup>s</sup>·9 and - 30<sup>s</sup> 2. Mr. A. F. Bennett, observing with a 6-inch refractor at Leiston, Suffolk, found corrections –  $15^8 \cdot 3$  and –  $29^8 \cdot 2$  Dr. A. C. D. Crommelin, observing with a 3-mch refractor, power 40, at Blackheath, found - 33s and - 48s. The last are undoubtedly too early, the power being inadequate for accurate observation. The fact that the contacts happened some twenty seconds ahead of calculation is confirmed by other observations; a similar result was obtained in the 1924 transit; this is the direction to be expected if the unexplained lunar irregularities are due to change in the rate of the earth's rotation. It is noteworthy that observations have been obtained in England of all the four transits in the present century.

NAKED-EYE SUNSPOT.—The appearance of a large group of sunspots near the sun's central meridian was noted by observers of the transit of Mercury on the morning of Nov. 10 By the following day the group had increased perceptibly, and it became a naked-eye object for two or three days, after which its approach to the west limb with consequent foreshortening prevented its being seen without slight optical aid. A photograph taken on Nov. 6 shows the group commencing as a small spot in some faculæ which could be identified with an earlier group of spots in the preceding rotation. The increase in the size of the spots and their changes in structure between Nov. 9 and 12 denoted considerable activity. The

magnetograph traces at Greenwich show, however, no unusual disturbance of the magnetic elements. Other particulars of this group of spots are given below.

No Date on Disc Central Meridian Latitude. Area

10 Nov. 6-16 Nov. 10 4 9° S. 1/800
of hemisphere

The Nucleus of Comet Pons-Winnecke.— L'Astronomie for October contains an interesting drawing of this comet made by M. F. Baldet with the great Meudon refractor at the time of its near approach to the earth last June. His photographs appeared in the September issue, but they were on an insufficient scale to bring out the extremely small size and sharpness of the stellar nucleus. The drawing is on a scale of 1 inch to 4"; it shows a well-defined central nebulosity 2½" in diameter, with a very minute stellar point in the centre. The latter was too small to measure, but M. Baldet estimates that its linear diameter did not exceed 400 metres. It presumably consisted of a compact swarm of meteoric masses. It is a matter of surprise that these have retained their compact formation for more than a century (the comet was first seen in 1819), in view of the large perturbations by Jupiter that it has experienced on several occasions.

A few weeks ago comment was made in this column on the compactness of the meteoritic swarm that is supposed to have formed Meteor Crater in Arizona by impact with the earth. The central portion of the present comet, if we accept M. Baldet's estimate of its size, seems to be of comparable dimensions. M. Baldet goes on to comment on the difficulty of supposing that such compact swarms are of great antiquity, and directs attention to the theory (first seriously proposed by R. A. Proctor) that the short-period comets are the products of eruptions from Jupiter. In this comnexion it is interesting to note that the astronomers of the Jungfrau observatory report an interesting outburst on Jupiter on Oct. 11. A small bright spot suddenly appeared in the equatorial zone (having somewhat the appearance of a satellite in transit). It seems to have disappeared after a short time; but the details to hand are telegraphic and meagre.

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# Research Items.

TOTEMISM IN SOUTH AMERICA.—Mr. R E Latcham, for many years a resident in Chile and a student of the history and ethnology of the Indian tribes at present inhabiting the Andean area and their predecessors, has made an exhaustive study of a mass of unpublished material stored in Spain and in South America, much of which has never been examined before from the point of view of the anthropologist. Many of these documents, especially the grants of Indians to the early Spanish colonists, recite details relating to the tribes which have provided evidence throwing an entirely new light, Mr. Latcham maintains, on the organisation and beliefs of the early Andean peoples. A study of their totemism based upon this material is published in the Journal of the Royal Anthropological Institute, vol. 57, Part 1 From this that appears that not only was descent matrilineal, contrary to what has been believed, patrilineal descent being introduced later under Spanish rule, but also their toternic system differed essentially in certain important respects from the standard system of other continents, though it presents close affinities with the system of North-West America The tribe was not descended from the totem, although they called themselves children of the sun, the lion, and so on. They had a common ancestor who had a separate cult from the totem, but to whom the original totem was ally and blood brother. Only occasionally was the totem an animal or plant, celestial bodies, natural phenomena, geographical features, and manimate objects were also chosen. These latter, however, might have a symbol; e.g. the falcon, eagle, and bustard were symbols of the sun, taking its place in many rites and ceremonies. sun, it now appears, was the totem of a special and powerful clan widespread over the country, and not the symbol of the Incas generally. The totem when an animal was sometimes, but not always, taboo. It might, especially in the coastal region, be chosen from among the annuals or articles which formed the staple diet of the tribes. Sometimes the totem was an animal having a special mark or defect. During ceremonial dances, the dancers dressed in the fur or feathers or some article symbolic of the totem. As a rule clans were exogamous.

TELEGRAPHISTS' CRAMP.—In 1922 the Industrial Fatigue Research Board was approached by the Union of Post Office Workers with a request to investigate the subject of telegraphists' cramp. resulting investigation (Medical Research Council, Industrial Fatigue Research Board, Report No. 43: A Study of Telegraphists Cramp. By May Smith, Millass Culpin, and Eric Farmer: H.M. Stationery Office. 1s. 6d) was directed towards finding "whether, and how far, there is a specific susceptibility A comparison was made between two groups. telegraphists certified as suffering from cramp, and others apparently free from it. Certain psychological others apparently free from it. Certain psychological tests involving speed and accuracy of movement were applied to both groups (test of pressure exerted, the ergograph test, and the McDougall-Schuster dotting test), and it was found that, with certain exceptions, the telegraphists in the non-cramp group showed better records than those in the cramp group. The subjects in both groups were then studied, with special reference to the presence or absence of psycho-neurotic symptoms. Again the two groups were not completely differentiated, but 75 6 per cent. of the cramp cases showed symptoms of psycho-neurosis, while of the non-cramp group 32.5 per cent. had these symptoms. The tests were repeated with a group of a hundred learners at the school of telegraphy, and it was found that amongst these the 'cramp type' could be differentiated. The working efficiency of the learners (based on the opinion of a superior officer) showed some relationship to their ability at the tests. Finally, a study of the psycho-neurotic symptoms of certain control groups was made, which suggested that the incidence of these symptoms among telegraphic workers was approximately normal. It appears, from the results of the research, that some preliminary selection of telegraphists by tests and examination would reduce the medence of cramp.

Pennatulids of Japan.—Prof. J. Arthur Thomson and Miss Nita J. Rennett, in their report on the collec-Japanese Pennatulids from Japanese waters ("Report on Japanese Pennatulids." Journal of the Faculty of Science, Imperial University of Tokyo. Section 4. Zoology, vol. 1, Part 2, 1927), record 24 species, none of which was not better the school of the section of of which is new, but they show interesting variations among the commoner forms, and valuable notes are given on those which are less well known. Three beautifully coloured plates show complete specimens of six species with details of others. Figures of spicules are given in the text. These spicules, absent in only a few forms, are some of the chief characters used to distinguish the species, genera, and even families. It is a vexed question whether to place the genus Scytalium in the family Virgulariidæ, the Balticinidæ, or the Pennatulidæ. The authors have solved the problem by creating the new family Scytalidæ, which agrees with the Ponnatulidæ in having pronounced pinnules but differs in having the spicules small and oval instead of three-flanged, whilst it is removed from the neighbourhood of the Balticinida and Virgulariidæ, which are without very pronounced pinnules. Anthoptilum thomsoni, which is figured in colour, natural size, is regarded as a species distinct from A. grandsforum, with which it was merged by Hickson and Kukenthal It is described as a "large, magnificent Pennatulid," measures 94 continuetres, and differs in many respects from A grandsforum. It has been previously recorded from the Atlantic, south of Buenos Ayres, at 600 fathoms.

REPRODUCTION IN UALANUS FINMARCHICUS.—Dr. G. P. Farran has recorded interesting observations on this important copepod (*Jour. Con. Internat. Explor. Mer.*, vol. 2, No. 2, 1927. "The Reproduction of Calanus finmarchicus off the South Coast of Ireland ' Investigations were undertaken by the Department of Fisheries of the Irish Free State and its predecessor the Fisheries Branch of the Department of Agriculture and Technical Instruction. A special area was chosen and samples taken at intervals from 1913 to 1924, a Nansen net of standard silk No 3 with a ring of 50 cm. diameter being used, hauled by a hand winch at an average rate of between 3 and 4 metres per second, and the total number of Calanus present and the proportions of the successive developmental stages estimated. Nauplii as a rule escaped through the meshes, therefore the copepodite stages only were noted (Stages I to VI, the sixth being the adult form). average catch for each month in a vertical haul from bottom to surface shows that April is the maximum month and March the minimum, although very few specimens were caught from September to February. The number of specimens in each month range from 75 to more than 34,000. There are, however, only few adults compared with the numbers of immature forms. Calanus finmarchicus in the area examined passes the

winter mainly in the late copepodite stages, then becoming adult in January, February, and Maich, but meantime the total stock diminishes rapidly, reaching a minimum in March. In April reproduction, which has already begun in March, is at its height, and is still going on in May, after which the numbers fall off gradually until September Calanus may reproduce irregularly all through the summer, and a few early stages may still be found in the autumn. The only record for January shows that there was a very large preponderance of males, chiefly in Stage V in 1921, females predominating in all the other months, adults especially in February and March. In April, Stages II and III, June to July, Stage IV; August, IV and V; September and November, VI. The author thinks it is probable that adults of the previous year do not live beyond April and May, their places being taken by specimens hatched earlier in the year which have rapidly gone through their metamorphosis. In the autumn the growth appears to be much slower; months instead of weeks being necessary to complete the development.

Useful Extracts from Japanese Forest Trees,—In the Journal of the College of Agriculture, vol. 9, No. 2, Imperial University of Tokyo, Ihachiro Miura gives some of the results of three years' labonious work on the determination of 'useful matters' contained in the forest trees of Japan. More than 100 species have been examined and analysed, and the results, given in tabular form, will form useful data for industrial chemists engaged on problems connected with plant products. The work is divided into six parts as follows: (1) Fatty oil contents in seeds of various forest trees; (2) contents and properties of tung oils from various species; (3) tannin contents in various forest trees; (4) the content of the methoxyl group in the principal forest trees, and its utilisation by dry distillation; (5) the growth of cinchona in Formosa and its alkaloid content; (6) the needle oils from coniferous trees.

THE CALCIFUGE HABIT IN MOORLAND PLANTS .-The occurrence of moorland plants on 'sour' or lime-deficient soils and their absence from calcareous soils has presented a problem of perennial interest to field botanists. W. H. Pearsall and Marjory Wray have investigated the problem in the case of Errophorum angustifolium in terms of (1) the calcium content of the soil solution, (2) its basic ratio, i.e. (K+Na)/Ca, and (3) its hydrogen ion concentration (Journal of Ecology, vol. 15, No. 1). These factors were controlled by using variations of Shive's threesalt culture solution as rooting media. The constituent elements of the solutions were varied in concentration within certain definite limits, and the effects on the growth and form of the culture plants were noted. In general, the effect of high calcium content in the culture solutions was a pronounced tendency to lowering of the water content of the plants as expressed in the ratio of fresh weight to dry weight. When the basic ratio was high, however. the effect of calcium was reduced. Change of acidity in the medium altered the calcium absorption, which was high when the hydrogen ion concentration was in the vicinity of pH 7, low in the region of pH 45. In a series of germination experiments it was found that in relatively acid media (pH 45) the most rapid germination took place in solutions relatively rich in calcium, while in neutral solutions (pH 7) germination was most rapid in media containing smaller quantities of calcium. These conditions are explained on the basis of the effect of hydrogen ion concentration on calcium absorption.

That climatic conditions may act as factors modifying the effects of calcium is indicated by varying the temperature and atmospheric humidity conditions of the experiments. Calcium effects were accentuated by low temperatures and dry atmospheres and decreased by the opposites. Under natural conditions similar effects seem to obtain. Analysis of soil waters showed concentrations of calcium and potassium similar to those used in the experiments.

EXTRACTION OF SUGAR FROM BEET.—An illustrated account of the various processes in the sugar beet factory at Poppleton, Yorks, is given in the *Journal* of the Ministry of Agriculture (vol. 34, p. 612). This factory, elected in the summer of 1926 by the Anglo-Scottish Beet Sugar Corporation, sliced its first beet m October of that year, and in the first three months of working extracted more than 7000 tons of white sugar from 53,233 tons of beet. After thorough washing, the beets are weighed, so that the quantity of raw material being dealt with during a given period can be ascertained if desired. The roots are then sliced preparatory to the extraction process, which is carried out by a modern method known as continuous diffusion.' The general principle of this method is the extraction of the sugar and other soluble substances by osmosis, the beet slices being made to pass in an opposite direction to a stream of water. exhausted pulp forms good stock food and is known as 'dried beet pulp. The extracted juice is then subjected to successive treatments of slaked line, carbonic acid gas, and sulphur dioxide, by which means impurities are precipitated and the liquor clarified. Evaporation, however, is necessary before crystallisation can be carried out, as the juice still contains a large quantity of water. The size of the crystals desired, which depends on the demands of the market, can be determined by conditions of temperature, vacuum, etc., during the boiling process When the mass of sugar and syrup has reached the appropriate stage it is centrifuged, whereby the crystals are retained and the syrup run off, the latter being reintroduced to the process as desired. The white sugar is dried by hot, followed by cold air, and after the lumps have been removed for remelting by 'shakers,' the finished granulated product is deposited in the sugar bins. At no time from start to finish is there any interruption in the process, nor is the product at any stage touched by hand. For the year 1927-28 more than 11,000 acres of beet are under cultivation for the Poppleton factory, and there is every prospect in this area that both the tonnage per acre and sugar content will show a marked improvement on the results of the previous year.

MAGNETIC OBSERVATIONS IN FRANCE.—The observations made at the two French magnetic observatories, Val Joyeux and Nantes, are now published under the auspices of the Institute of Physics of the Globe (of the University of Paris). Tome 5 of the Annales, recently issued, contains the results for 1925. including complete hourly values for Val Joyeux, and four hourly values per day for Nantes; the Val Joyeux records for nine disturbed days are reproduced graphic-Magnetic survey observations made in various parts of France are included in the volume, and also arctic magnetic and electric observations made on board the vessel Pourquoi Pas ? in 1926. The Director, Prof. Maurain, contributes three interesting discussions of the now long series of magnetic records at Val Joyeux and Parc St. Maur, relative to their correlations with sunspottedness, and to their annual variations. The seismological, meteorological, and actinometric observations at Parc St. Maur are also given, in summary.

MILD STEEL UNDER PROLONGED STRESS AT 300° C. -W. Rosenham and D. Hanson, in connexion with a study of intercrystalline cracking in boiler plates, have carried out prolonged tests of mild steel under loads ranging from one-third to two-thirds of the normal tensile strength of the metal at a temperature of 300° C. The results are given in a paper read at the Glasgow meeting of the Iron and Steel Institute. The loads have been maintained almost uninterruptedly for more than five years. The material used contained 011 per cent. carbon and 0.4 per cent. manganese, the other elements present being very low. Test-pieces in several different conditions of heat treatment were employed, and at stresses up to two-thirds of the normal maximum stress at that temperature, no case of fracture was observed. In one case only was there any appreciable extension. A sample coated with solder behaved in the same manner as the remainder of the specimens Brinell hardness of the steel increased to a marked extent in the stressed portions of the test-pieces, a result which is regarded as being remarkable in view of the small amount of deformation which the steel underwent. In connexion with the failure of boilers, the results are of value in proving that stress alone at the high temperatures does not lead to the type of fracture which is observed, and confirm, therefore, the view that both stress and chemical attack are necessary to produce the cracking. It is pointed out that the results were obtained on specimens free from notches, and for the present can with certainty be applied to such material only.

The Element 'Mosandrum' of J. Lawrence Smith.—In the issue of the Journal of the Washington Academy of Sciences for Sept. 19, R. C. Wells discusses the discovery of samarium, gadolinium, and europium. In 1877, J. Lawrence Smith, who was working on earths obtained from samarksite, claimed to have found a new element which he called mosandrum. About this time various chemists, including Delafontaine, Soret, and Marignac, were claiming to be discoverers of new elements, and Smith's claims received little support. Samarium was definitely isolated nine years later as a result of the spectroscopic work of Lecoq de Boisbaudran. Although it must be admitted that Smith's preparations were impure, he recognised the presence of a new element in samarksite. His element mosandrum later proved to be at least two elements, afterwards called samarium and gadolinium.

ACTIVE NITROGEN AND THE METALS.—The September issue of the Journal of the Chemical Society contains an account by E. J. B. Willey of the catalytic effect of certain metals in accelerating the decay of active nitrogen. It is suggested that clean cold metals generally have no effect upon the afterglow owing to the formation of a protective film of nitride. The active gas was passed at measured rates over a metal filament which served both as a resistance thermometer and a heating coil. An increase in temperature was observed with various metals due to the endothermic decay of the active nitrogen, but the greatest effect was obtained when a platinum filament thinly coated with copper was used. In this case 'spattering' of the copper took place, but this disintegration did not occur with other metals. It was found that iron, platinum, and silver become active catalysts for the destruction of the afterglow at the temperature of decomposition of their nitrides. The approximate value 46,600 cal./gm.mol. was obtained for the energy of active nitrogen.

THE ACTION OF LIGHT ON CHLORINE.—An interesting contribution to the photochemistry of chlorine is found in a recent paper by G. B. Kıstıakowsky in the Journal of the American Society for September. After briefly reviewing the literature on the nature of the primary action of light on chlorine, the author points out that all the existing theories which assume the presence of foreign molecules to be essential for the initial photochemical process also assume that pure chlorine fluoresces on exposure to light. It is shown that there is no appreciable difference in the total absorption of polychromatic light by very dry and by moist chlorine. Moreover, there is no change in the absorption spectrum upon extreme drying of the gas, and only a small fraction of the absorbed light energy can be re-emitted as fluorescence even in very dry chlorine. Hence, since the Budde effect undoubtedly decreases on drying chlorine, the introduction of the same amount of light energy may or may not cause a heating effect according as impurities are present or absent It is rather difficult to reconcile the new data with those theories that assume that the presence of foreign molecules is necessary for the primary photochemical process in chlorine. It is suggested that the gas is dissociated into atoms on the absorption of light independently of its degree of purity. The recombination of atoms to molecules liberates the absorbed energy as heat, but in the dry state this process must be assumed to be very slow and to take place only on the dry walls of the containing vessel, the large heat capacity and relatively good conductivity of which prevent the Budde effect. A difficulty arises in this explanation in that if moisture has a catalytic effect on the recombination of atoms, it should also accelerate the thermal dissociation of chlorine molecules.

STRUCTURES IN SEA WATER.—The committee of the Institution of Civil Engineers which has been studying the deterioration of structures of timber. metal, and concrete in sea water has recently issued a seventh report of an interin character (London: H M. Stationery Office. 2s.). Specimens of iron and steel have now been kept under observation in several parts of the world, but it is difficult to sum up the results in any simple way, as the relative behaviour of different steels varies in different harbours. Highly alloyed steels seem to have some advantage. A set of 330 mild steel plates, coated with various protective paints and coverings, has been exposed in Southampton Docks, and after a year there are marked differences in the extent of wasting and pitting, but again it is difficult to express a general conclusion. In regard to the protection of timber against the attacks of Teredo, the effect of various arsenical compounds has been examined. The protection depends largely on the extent to which the poison enters the wood, and Prof. Barger reports that a 'mixed oil,' containing 60 per cent. of phenyl arsenious oxide together with chloride, penetrates best. Limnoria is more resistant to poisons than Teredo. The organic arsenical compounds are evidently of great value in this connexion. Creosoting of timber by a low temperature process, the excess of creosote being extracted, has little effect on the mechanical strength, but the high temperature process has a deleterious effect, probably increased by the excess left in the wood. Investigations on the deterioration of marine piling are also being carried out in the United States, and an abstract of the report to the American Railway Engineering Association has been included. It appears that Australian turpentine wood has a high natural resistance to attack by borers.

# The Salisbury Meeting of the South African Association for the Advancement of Science.

THE twenty-fifth annual meeting of the South African Association for the Advancement of Science was held at Salisbury, Southern Rhodesia, on June 29-July 4, under the presidency of Prof H B. Fantham. The meeting was very well attended and ninety-three papers were read. Joint meetings of several sections were held The South Africa medal and grant were presented to Dr. Annie Porter at the conclusion of the presidential address. A popular lecture was given by Dr. A. L. du Toit on "The Kalahari and some of its Problems." There was a reception by His Excellency the Governor of Southern Rhodesia at Government House, and visits to various places of scientific interest in the neighbourhood.

The president, Dr. H. B. Fantham, gave as his address, "Some Thoughts on Biology and the Race" Dr. Fantham stated that it is to be regretted that the study of the general applications of science to everyday life are still so little evident in the education of the average citizen of South Africa He is whole-heartedly in favour of the retention of classical and cultural subjects in the high school curriculum in South Africa, but every pupil should also become acquainted with both physical and biological science during his school career. Educa-tion is not a failure, but 'what passes for it' is at fault, such as the undue desire of parents and pupils for the mere passing of examinations: in other words, the informative function has overwhelmed the truly educative function. It tends to be overlooked that all men are not born equal in inherent capacity, that is, that variation exists. Consequently, the ideal of a university as a home for culture and the training of real leaders is being supplanted by mere utilitarianism. In South Africa matriculation has become a fetish and hence a disappointment.

There is much to be said for the correctness of the aphorism that the white race must form an aristocracy of labour in Southern Africa, but it is doubtful if the idea is being fulfilled practically. Vocational training is necessary, but must not be entirely divorced from culture and must not be undertaken too early. Psychology and education must be founded on biology. Even civilisation itself must depend on the principles of biology for its constitution. One of the saddest features of the modern educational system in South Africa is that the best types of students are not desirous of entering the teaching profession. One great value of biological training is the appreciation of cause and effect and the application of these to everyday affairs. Such implies personal effort or striving, personal observation, personal thinking. To-day, however, the mass of the people seem to be merely absorptive, and adopt the views of the press or pulpit or party politician. The ideas of life as seen in the cinema, catchwords, phrases, and slogans are much to the fore. Minorities often represent the variations most fitted to survive. Many parents do not realise that they are delegating most of their parental responsibilities as regards education to the government and to the teachers

A knowledge of biology would inculcate in the parents, the presence of natural variation among children and would indicate that full opportunities should be afforded to all children for development and progress so far as their inborn or hereditary qualities allowed. If such an elementary knowledge of biology were in possession of the masses, there would be less false pride, fewer occupational misfits, more skilled craftsmen, and a truer appreciation of the dignity of manual labour. At present we are told

that we must be up-to-date and not 'old-fashioned'; in education we are told 'to follow the child' in spite of the fact that the young are immature learners. Surely a continuity should be preserved with the past and its heritages. The unfortunate disharmony that so often occurs in thought between succeeding generations is a real danger to civilisation and merely leads to repetition of old blunders. Discipline, which is such an irksome term to some modern people, only means ordered activity as opposed to disorder and chaos. A study and knowledge of biology will inculcate this discipline as perhaps no other subject can do.

Turning to another aspect, it may be remarked that probably the great cost of social services to modern white communities has been accepted by most people as a necessary expense. In South Africa, however, the financial burden is too great for the white race to carry Over-administration is a soulless, bad master biologically and has led to reaction on the part of the organisms over-administered, producing a state of lethargy and apathy (as shown by individuals not voting at elections) or else a state of violent re-action manifested by Communistic activities. Turning to the eugenic aspect, the subject of differential fertility is most important. At present, many excellent hereditary strains are in danger of being lost or are actually being lost, while the thoughtless and irresponsible are relatively increasing in numbers. As regards the colour problem in South Africa, it should be kept in mind that the real aim should be to make the native African a happier and more capable African, and not a caricature or imitation white man. At present there is not enough incentive to real effort on the part of the whites.

Biological training should be begun in early life and should receive special attention in the high schools. Biology has done much for the economic life of the people already, and more can be done. By the study of biology, humanity should be brought into harmony with the great world of Nature and carried above the smallnesses of parochial outlook and party politics. In attempting the improvement of the human race, even to a small degree, co-operation and goodwill are necessary, and by calm, dispassionate biological consideration, much can be done to break down barriers of ignorance. By service and sacrifice as a people shall we attain harmony with Nature and the infinite

An account was given of "Irrigation and Water Supplies in Southern Rhodesia," by Mr. A. C. Jennings in his presidential address to Section A. Southern Rhodesia, having no seaboard, has developed from the mland plateau along the headwaters of the rivers. In regard to irrigation, he advocated the small individual scheme, for successful irrigation requires not only good land and an assured water supply, but also a population capable of using the water to the best advantage. Rhodesia lacks population at present. Practically all irrigation is carried out by Europeans, natives making very little use of water, even when easily available. Most schemes use direct flow of rivers without recourse to conservation, and the land is devoted to mixed farming. As water and land are still comparatively cheap, there has been little inducement to effect the most economical use of the water. Investigations have been begun on urrigable possibilities of many of the larger rivers, using both normal flow and flood discharges. Conservation needs more attention and should be a national concern. Potentialities for development of water power are considerable. No general artesian basin exists, but

ground water is encountered often about 60 feet deep. Irrigation machinery has been designed and built in Rhodesia and has proved superior to imported plant.

Mr. H. B. Maufe discussed "Some Problems in Rhodesian Physical Geology" in his address to Section B Incompleteness of topographical maps has rendered many lines of research work difficult. The past geological history and present topographical features of Rhodesia were detailed Southern Rhodesia has its high ground in the form of an elevated plateau running from south-west to north-east, with mountains arising from low ground around, the high level plateau having been uplifted at the end of the Phocene, when the climate became more humid and rivers gradually carved out the valleys. The old plain, only slightly eroded, was recognisable in the main watershed, iunning from south of Bulawayo to east of Salisbury. The differences in the two types of Rhodesian scenery are not due to differences in geological structure, great stretches of flat country being found where there has been but little erosion, and hill ranges and isolated kopjes where the rivers

have cut into the flanks of higher ground.

Prof. R. S. Adamson chose "Some Problems of Vegetation in South Africa" as the subject of his presidential address to Section C The problems of a survey of the botanical resources of the Empire were mentioned, these being based on ecology. In South Africa, taxonomic work is a necessity and ecology has received less attention, but vegetation study is essential. The characters of plant succession were discussed and also vegetal changes due to climate, concerning which more accurate information is desirable. Changes due to interference, by destruction particularly of the climax vegetation and reversal of succession were noted. The recognition and definition of communities as units of vegetation study were discussed and illustrated by reference to the plant communities of the Cape region, where the flora is exceedingly rich and varied, and the 'biological spectrum' was set forth. The similarity of the Cape Fynbosch communities to those of the Mediterranean coasts, California and S. W. Australian coasts, with similar climatic conditions, was noted and various hypotheses were given to account for variability of the flora. The practical advantages of the study of plant communities in grazing, farming, afforestation, or fruit culture were indicated.

"The Teaching of Zoology in South African Schools" was the subject of Dr. S. H. Skaife's presidential address to Section D. He showed statistically that in order to give every school child some training in scientific method, the nature study course, including animal life, in the primary school must be employed. In the secondary school he advocated a four years' course in general science and not premature specialisation, as too often occurs. This should include zoology, botany, physics, and chemistry. The aim should not be to train experts in any one branch, but to create and foster a scientific attitude of mind In schools, the majority of the pupils take the matriculation course, adapted to the needs of the few who proceed to the university, and the regulations for matriculation only exceptionally allow of more than one science subject being taken, and amendment of the regulations was urged. Zoology as a school subject is of great importance and high educational value and needs better development. All teachers-intraining should receive a course in general science as part of their training. More attention to zoology as the science of living things should be given.

Rev. Neville Jones, in his presidential address to Section E, made "Some Remarks on the Present Stage of Prehistoric Research in South Africa."

The abundance of archæological relics and the recognition of three Newer Stone Age industries in South Africa were noted. The Stilbaai and Smithfield industries were regarded as specific to the Union of South Africa, but the Wilton occurred throughout the subcontinent and was probably the basal industry. In Rhodesia two industries referable to the Wilton and an older cave industry exist. An extensive Wilton workshop and distributing centre was at Sawmills: the Matopo caves yielded Wilton microlithic implements. All over South Africa evidence of a race or races equivalent to the Upper Palæolithic of Europe existed. The evolution of the Bushman and the question of the origin of the San races were discussed. The probable existence of an earlier race intermediate between the older and newer stone ages, that may have contributed to the evolution of the San people, was indicated by the occurrence in caves of implements showing a technique like that of the Mousterian of the Palæarctic. Evidence of contemporancity of these stone ages is lacking. Stellenbosch industry shows much correspondence with the early stone age of Europe, and it is thought that the European makers of Chellean implements made their way to South Africa. There are great opportunities for research in South Africa.

The presidential address to Section F on "Some Observations on the Economic Position of the Native in Rhodesia" was delivered by the Hon. W. M. Leggate, who showed by concise words and figures that the rate of progress in Southern Rhodesia and the present output of that colony in both mining and agriculture are due to the employment of native labour under European direction. The presence of a small proportion of Europeans with capital and organising ability has greatly increased the producing power of the native, who has benefited greatly in agriculture and stockfarming. In mining, the presence of the native has made it possible to work grades of ore that would be impossible if white labour only were used. Without the native, double the present white population would not maintain its present level of production, but, without the European, native production would revert to negligible proportions. The natives object to differentiation in pay whatever their capacity as workers, and differential training of the native will have to be applied gradually in consequence.

A few remarks may be made on the work of the Sections.

In Section A the hydrographic conditions, measures against soil erosion, and the variability of rainfall in Rhodesia were discussed. Engineers were interested in experimental work on water hammer and physicists in electric charges of bacteria.

Rhodesian geological problems were prominent in Section B. The pre-Cambrian atmosphere was discussed. Fossil Widdringtonia occurring in the Knysna forests, where living Widdringtonia abound, were of interest to geologist and botanist. A joint meeting was held with Section D for an important paper on the influence of variation in the ration on the assimilation and retention of minerals in farm animals. When oil is added to the ration, the calcium balance of pigs shows progressive increase, and sodium chloride or citrate added to a cereal ration causes increased assimilation and retention of nitrogen, calcium, and phosphorus.

In Section C there were valuable papers dealing with forestry, ecology and bacteriology. The behaviour of South African tree seedlings and seeds in artificial habitats were discussed, dendrographic experiments in the Knysna forests described and accounts given of *Ekebergia capensis* and Oxytenanthera. Discussions of *Clostridium botuliumin*, contagious abortion and undulant fever were of interest to

bacteriologists, and descriptions of native cattle in Rhodesia and of new fungi appealed to agriculturists.

Many subjects of wide range were discussed in Section D. An important contribution was made on the breast-shoulder apparatus of Xenopus, Pipa, and Hymenochirus. Protozoology included papers on soil Protozoa, Herpetomonads and Bodo found in the hind gut of the snake, Homalosoma lutrix, and the biological reactions of a Herpetomonas from Lucilia sericata. The distribution of Anophelini and Glossinæ in Rhodesia was described. A series of papers dealt with the structure and evolution of the fleece of various breeds of sheep. A skin of the new Cooper's cheetah, Actnonyx rex, was exhibited by its discoverer. A joint meeting was held for a paper on South African cases of racial admixture, the colour variations, poor physique, instability of character and social inheritance of such cases being discussed. A tribute was paid to the memory of Francesco Redi at his tercentenary.

A series of papers in Section E on the social anthropology of the Bomvana, Bavenda, Mashona, and Zulu peoples was of much interest, as were discussions on the religious ideas of Rhodesian natives. Stone implements of various types from several sites were discussed, and enthusiasm was aroused by the announcement of the discovery of true burns near Grahamstown. Some large and interesting collections of copies of Bushman paintings were exhibited.

In Section F the nature of attention, the distinctions between tendency, ability, and capacity, and Descartes' second meditation interested philosophers. Papers of interest to economists dealt with the industrial revolution, Indian indentified immigration into Natal and the need for the teaching of economics in South

African schools.

The next annual meeting of the Association, under the presidency of Sir J. Carruthers Beattie, will be held at Kimberley in July 1928.

#### World Weather Records.1

THE publication by the Smithsonian Institution of a collection of long-period records of pressure, temperature, and precipitation marks an important step forward in the investigation of the relationships between weather conditions in different parts of the world. The work of Prof. Exner, Sir Gilbert Walker, and others, has shown that there is some general system underlying the at first sight irregular fluctuations of weather, and that, for example, the variations of rainfall in India can be forecast from variations of meteorological elements so far afield as South America. These relationships are being sought for by the calculation of correlation coefficients between variations of meteorological elements at many different stations, a process which requires long and trustworthy records. Hitherto it has been necessary for each worker in this field to compile his own tables from the annual and monthly meteorological reports of the various countries, but at the International Mcteorological Conference in 1923, Prof. Exner proposed that all meteorological services should be asked to publish series of observations covering as long a period as possible provided homogeneity was maintained, for selected stations in their areas, at distances of 500 or 1000 kilometres. This suggestion was approved by the Conference, which passed a resolution inviting the following meteorologists to give it practical effect: Dr. (Sir Gilbert) Walker for Asia, Prof. Exner for Europe, Mr Clayton for America, and Dr. Simpson for Africa, Australasia, and the Oceanic Islands Mr. Clayton afterwards delegated the collection of data for South America to Mr. R. C. Mossman.

The four collectors commenced the work immediately by writing to the directors of meteorological services all over the world requesting copies of their long records, with details as to corrections, etc., and emphasising the importance of homogeneity. The requests met with a gratifying response, and by September 1926, when the International Meteorological Committee met in Vienna, the collection of the data was approaching completion. At that meeting Mr. Clayton was able to announce that the Smithsonian Institution would undertake the publication of the data, and that an American donor, Mr. John A. Roebling, had offered to defray the cost. This generous offer was accepted, and Mr. Clayton agreed to see the tables through the press.

¹ Smithsonian Miscellaneous Collections, vol 79 World Weather Records, collected from official sources by Dr. Felix Exner, Sir Gilbert Walker, Dr. G. C. Simpson, H. Helm Clayton, Robert C Mossmann; assembled and an anged for publication by H. Helm Clayton Published under grant from John A Roebling. (Publication 2013) Pp. vi+1199. (Washington, D.C.: Smithsonian Institution, 1927.)

The results of all this team work are now before us m a volume of some 1200 octavo pages, bearing the title "World Weather Records," which forms volume 79 of the well-known Smithsonian Miscellaneous Collections. Data are included from 385 stations. ranging from Upernivik in the north to the South Orkneys in the south. Very nearly all the series cover more than twenty years, commencing before 1900 and ending in 1920, or later in the case of the American and some other stations: shorter series were included only when the situation of the station gave it outstanding importance At a moderate estimate the tables include some quarter of a million monthly and annual means or totals. The units in which the data are expressed are those in which they were supplied by the Services concerned. The hundred thousand or so of conversions which would have been necessary to secure uniformity would have involved great labour and some risk of the introduction of errors, but quite apart from this the policy adopted was undoubtedly the wisest, and one would say the only practicable one. The tables are preceded by a number of pages devoted to explanatory notes, some of which give the whole history of the station concerned—a mine of reference—and they are followed by a useful list of relative sunspot numbers from 1749 to 1925.

Finally, a word must be said about the arrangement. The three tables—pressure, temperature, and precipitation—for each station are kept together, and the stations for each continent are kept together, in alphabetical order. There is an index of all stations and countries in alphabetical order, and another in which the stations are arranged by tendegree zones of latitude, the names in each zone running from west to east; this index gives the geographical co-ordinates. Thus whether one requires a station by name, by country, or the nearest station to some particular point, reference is equally easy.

The volume fills a need long felt by meteorologists, and by the assistance which it provides for statistical research it will certainly lead to results of great practical value. It remains only to express our gratitude to all who have had a part in its production, to the directors of the various meteorological services which have supplied data, to the five meteorologists who have organised its collection, to Mr. Clayton who has had the strenuous task of assembling and arranging the matter and seeing it through the press, and last but not least to Mr. Roebling, whose generous financial assistance has placed this invaluable collection of data within our reach.

# Forestry in Trinidad and Tobago.

THE Annual Administration Report of the Forest Service of Trinidad and Tobago for 1926 contains several points of interest connected with future forest policy. The writer states that the reasons for maintaining a certain area of the Islands under forest are twofold: first, the conservation of those forests of indirect utility owing to their protective value in maintaining favourable climatic conditions such as the maintenance of rainfall, humidity, prevention of erosion, and to act as windbreaks; secondly, the management of such areas as may be necessary for the purpose of providing the Colony in perpetuity with timber, firewood, and other forest products. The first object has been already accepted as essential by the authorities As regards the second, the Conservator writes: "Although faint flutterings to this end may be discerned a real live forestry conscience, willing to face facts and, having done so, to act up to them, has yet to be awakened." Yet these facts, as stated in the report, appear to be sufficiently obvious under existing world conditions.

In recent years the annual consumption of wood in Trinidad and Tobago amounts to more than 2,000,000 cubic feet from Crown lands, nearly 1,000,000 cubic feet of sawn timber imported from the United States and Canada, and a considerable quantity (statistics unavailable) from private lands—the annual per capita consumption being more than 100 board feet. In tropical regions the timbers are classified into soft woods and hard woods, both being broad-leaved species of trees. Trınıdad possesses excellent soft woods, such as Cedrela mexicana, Carapa guianensis, Cordia alliodora, etc., but they occur, as is usual, m mixed forests and not in pure stands. Their utilisation in the past has been affected by unlimited supplies of cheap imported comferous soft woods from the United States and Canada; consequently, as in other tropical countries, doubt has been cast on the suitability of the local soft woods for general purposes. The experiments undertaken by the Forest Department on seasoning local timbers have shown that this belief is mainly due to the lack of proper seasoning and grading methods, the Conservator pointing out that unseasoned pine timber would be equally unsuitable. Owing to the rise in price of the imported material, large and increasing amounts of local soft woods are used every year. Of the two million cubic feet of local timber used annually, possibly a fourth is soft wood, the Colony's consumption of the latter

material being therefore about 1½ million cubic feet annually. After discussing the threatened diminution in the world's supplies of soft wood coniferous timber, the writer points out that the price will certainly rise and that the Colony will be forced to depend upon its own supplies of soft woods to an increasing extent. To replace this drain on the forests, he advocates a large re-afforestation or planting campaign, suggesting that the annual surplus from the forests, which amounted to £7000 m 1926, should be devoted to this purpose.

As regards the hard woods, it appears that the Colony is well supplied and that some of them may be utilised to replace soft woods when the articles to be manufactured can be turned out by machinery. Balata (Mimusops) and pour (Tecoma) are the favourite hard woods, but mora (Dimor phandra) has been successfully used for flooring, after seasoning, by the Government engineers. The Colony, it is remarked, has always been self-supporting in hard woods. In connexion with cedar, it is of interest to note that 19,632 cubic feet cedar logs, valued at £3085, were exported, chiefly to Germany and Holland, during the year, for the manufacture of eigar boxes.

The accounts of the work in progress in the Colony, including research, amply prove that the Forest Department is devoting itself to the conservancy and care of the forests. It must, therefore, be all the more disheartening to the Conservator to find his administration crippled by the want of the necessary staff. He has two deputy Conservators in charge of the north and south of the island. He had applied for a third to act as his assistant at headquarters whilst he was on tour This post has been refused. The report shows that there are only 1000 acres of plantations in the Colony, and recommends, for perfectly sound reasons, the afforestation of 40,000 As the writer well states: "The acres by 1970 Forest Department can only point out facts." He details the facts, and in support of his suggestions quotes from the report of the recent Imperial Conference (on the subject of forest policy): "It points to the need of all countries maintaining and extending, where possible, their existing forest areas under a system of management based on sustained production of timber." The report would appear to have made out a strong case for such action being taken by the authorities of Trinidad and Tobago.

#### Gaseous Combustion.1

I. FINCH AND L. G. COWEN.—Gaseous combustion in electric discharges. Part II Ignition of electrolytic gas has been studied under different conditions of pressure and current. Ignition occurs immediately, i.e. without lag, on attainment of the igniting current, and a hyperbolic relationship exists between pressure and igniting current. Excess or deficiency of water vapour raises the value of the igniting current Flame is propagated at least ten times more rapidly along the path of the discharge than elsewhere. It is concluded that ignition is determined by the concentration of suitable ions, in the building up of which water vapour plays a rôle, and that flame propagation is also essentially an electrical phenomenon.

D. T. A. TOWNEND.—Gaseous combustion at high pressures. Part VIII. The explosion of methane with up to its own volume of oxygen at initial pressures up to 150 atmospheres. A study has been made of the

<sup>1</sup> Substance of papers before the Royal Society on Nov. 10

composition varying from 5:1 to 1:1, and (Series 2) a 1:1 mixture with  $3\cdot76R$ , where R is nitrogen, argon, or helium. In Series 1, increasing the initial pressure (a) raises the upper limit of explosibility, and (b) in the case of mixtures containing upwards of 60 per cent. of methane, not only increases the violence of the explosion, but also diminishes and in some cases suppresses altogether, carbon deposition.

explosion of (Series 1) methane-oxygen mixtures of

In Series 2, ntrogen appears to behave normally as a diluent only. The influence of helium as compared with argon is to shorten the time taken for the attainment of maximum pressure as well as to increase the subsequent rate of cooling. The corrected  $P_m/P_1$  ratios, however, were always greater in the case of explosions of the argon diluted mixture. The results accord well with the hydroxylation theory of hydro-

carbon combustion.

A. EGERTON AND S. F. GATES — Further experi-

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ments on explosions in gaseous mixtures of acetylene, of hydrogen and of pentane. Measurements are given of velocities and positions of detonation of acetylene, of pentane, and of hydrogen mixtures with oxygen, nitrogen, and argon at initial pressures up to 6 atmos. in a steel tube 15 cm in diameter. Experi-

ments in a bomb of comparatively large diameter give some evidence of auto-ignition during the progress of combustion of a vibratory character in certain acetylene mixtures. Lead tetraethyl delays the rate of combustion of the pentane in mixtures of acetylene and of pentane.

# Photosynthesis.1

E. C. C. BALY, J B. DAVIES, M. R. JOHNSON, AND H SHANASSY—The photosynthesis of naturally occurring compounds. I. The action of ultra-violet light on carbonic acid. When an aqueous allements of the product of the produ carbonic acid in quartz tubes is exposed to ultra-violet light, a photostationary state is established. Ordinary formaldehyde is not a component of this equilibrium, but there is present an organic compound which is probably a complex aldehyde. Ferrous bicarbonate in aqueous solution is converted by ultra-violet light in the absence of oxygen into ferric hydroxide, organic compounds with reducing properties being simultaneously formed. This reaction appears to take place mainly on the surface of the quartz tubes in which the solution is exposed to the light, and also on the surface of the iron rods used When an insoluble powder, capable of adsorbing carbonic acid on its surface, such as aluminium powder, barium sulphate, freshly precipitated aluminium hydroxide, or the basic carbonates of aluminium, magnesium, and zinc is suspended in water through which is maintained a stream of carbon dioxide, and the whole is exposed to ultra-violet light, complex organic compounds are photosynthesised. These may be recovered by evaporation of the solution after removal of the insoluble powder The total quantity of organic compound produced is about 0 02 gm. in two hours when eight quartz test tubes,  $9 \text{ m.} \times 1 \text{ m}$ , containing in all 720 c c. of water and the suspended powder, are exposed to the light from a 220-volt U-shaped lamp at an average distance of 6 cm. The organic compounds thus produced would seem to be of the nature of complex carbohydrates. In the presence of ammonium bicarbonate complex organic compounds are produced which contain nitrogen. Photosynthesis of complex organic material containing nitrogen also takes place when nitrite of potassium or barium is present.

E. C. C. Baly, W. E. Stephen, and N. R. Hood.—The photosynthesis of naturally occurring compounds. II. The photosynthesis of carbohydrates from carbonic acid by means of visible light. When carbonic acid, adsorbed on the surface of nickel or cobalt carbonate suspended in water, is exposed to visible light, photosynthesis of organic compounds takes place. The material contains a carbohydrate which reduces Benedict's solution, gives the Molisch and Rubner reactions, and forms a solid osazone and also contains

<sup>1</sup> Substance of papers before the Royal Society on Nov. 10.

one or more complex substances which are hydrolysed by acid to give substances which reduce Benedict's solution. For equal areas of the suspension exposed to the light, the yield of organic products is greater than that obtained with white powders in the light of the quartz mercury lamp. The percentage of carbohydrates in the products photosynthesised with a coloured surface in white light is greater than it is when white powders are used in ultra-violet light. If ammonium bicarbonate solution containing nickel or cobalt carbonate in suspension is exposed to visible light complex nitrogen compounds are photosynthesised. The shift in the exciting wave-length from the ultra-violet characteristic of carbonic acid in solution to the visible region characteristic of natural photosynthesis has been achieved in the laboratory. The photosynthesis by means of visible light has the advantage in that the photochemical decomposition of the products is avoided. Further, the special difficulties connected with the use of quartz apparatus with ultra-violet light are removed. The oxygen set free during the photosynthesis tends to poison the

surface, which slowly recovers itself under water.

E C C BALY AND J. B. DAVIES.—The photosynthesis of naturally occurring compounds.—III. Photosynthesis in vivo and in vitro. A marked similarity exists between photosynthesis in vivo and that achieved in vitro The following features appear to be common to both. Ordinary formaldehyde does not take part in the reaction in either case. laboratory process has been realised by the action of light on carbonic acid adsorbed on a surface. A limiting surface seems to exist in the chloroplast visibly coloured surface and visible light function in each process. Marked fatigue effects are observed and there is a slow recovery reaction. It appears that m both cases the photosynthesis must not proceed at a more rapid rate than that recovery reaction. It seems possible that the constant ratio of chlorophyll A to chlorophyll B in the living leaf is maintained by the carotin, which becomes oxidised to xanthophyll; the ratio of xanthophyll to carotin tends to increase during photosynthesis, so the slow recovery process may be due to the reduction of xanthophyll to carotin again. The orientation of the chloroplasts with respect to the direction of the light rays seems to be one of the details of this mechanism controlling the rate of photosynthesis.

## Surface Reactions.<sup>1</sup>

M. Francis and F. P. Burt.—Sorption of ammonia by glass. The quantities of ammonia taken up by a known surface of glass under constant temperature and pressure conditions, and the rates of sorption, have been measured over a temperature range of 0° to 200° C. and a pressure range of 100 mm. to one atmosphere. The experimental attainment of equilibrium proved impossible, but limiting values were assessed by a process of extrapolation. Though complete desiccation of glass is impracticable, it is possible to maintain it indefinitely in such a condition that its behaviour towards ammonia can be closely

<sup>1</sup> Substance of papers before the Royal Society on Nov. 10.

recovered The shape of the sorption curve depends on the dryness of the sorbent. The sorption process can be divided into two parts represented by straight lines when log sorption rate is plotted against log time. The slope of both lines is independent of pressure and varies only slightly with temperature, and their point of intersection corresponds, in all cases, to 50 per cent. sorption. By a suitable choice of co-ordinates the complete sorption process can be represented as a single-valued continuous function of temperature, pressure, and time. As regards temperature variation, this is only approximately true. At 50 per cent. sorption, the rate of sorption is nearly

proportional to the pressure at constant temperature, and is doubled for every 20° C. rise in temperature at constant pressure. At constant temperature, log sorption, in the limit, was found to be a linear function of log pressure between 0.5 and 1 atmosphere. At lower pressures a departure from linearity was observed. At constant pressure, sorption, in the limit, was found to be inversely proportional to the

absolute temperature.

G. I. FINCH AND J. C. STIMSON.—The electrical condition of hot surfaces during the adsorption of gases Part I Gold and silver surfaces at temperatures up to  $850^\circ$  C. A gold or silver surface becomes charged when heated either in contact with a gas or m a high vacuum. The charge is characteristic of the gas and dependent on the temperature and previous history of heating of the metal, but independent of the gas pressure. Evacuation of a gas removes the corresponding charge slowly in the case of oxygen or air on gold, and oxygen, air, or hydrogen on silver; but rapidly in the case of all other gases examined. The value of the charge due to a mixture of two gases, whether reacting with each other or not, is intermediate between the charges of the component gases and, as a rule, identical with that due to the reaction product. It is concluded that the charging of the surface is due to 'activation' of the gas, whereby the gas molecules are electrically charged. With oxygen, some become positively charged and remains thus charged on the surface, and some becomes either positively charged and quits the surface in this condition, or is negatively charged and remains on the surface. Gases other than compounds of oxygen are, on 'activation,' either positively charged and quit the surface in this condition, or are negatively charged and remain on the surface Oxygen forms an oxide with gold or silver, and hydrogen a hydride with silver. The 'activating' powers of the surface are greater towards oxygen than towards nitrogen or carbonic oxide, but very approximately the same towards oxygen and hydrogen. The 'activation' of water vapour or earbon dioxide involves at least dissociation of the gas. Vapour of the metal is activated in the process of leaving the surface.

D. R. HUGHES AND R. C. BEVAN.—A study of the catalysis by mckel of the union of hydrogen and oxygen by a new method. When hydrogen and oxygen at a low pressure are caused to combine at the surface of a nickel wire heated electrically, there is no alteration in the appearance of the wire, although the wire is covered completely with a very thin film of nuckel oxide while the catalysis of the reaction is in progress. The extent of the surface covered by the film can be measured by estimating the heat lost by the wire when it is maintained at a fixed temperature in hydrogen at a low pressure Under the same conditions the heat imparted to the hydrogen by a wire covered with a film is much greater than that communicated to the gas by a wire having a metal surface. The thickness of the films varies between  $3\times10^{-7}$  cm. and  $9\times10^{-7}$  cm. It is therefore incorrect to speak of the catalysis of the interaction of hydrogen and oxygen by the metal nickel.

B Lambert and A. M. Clark.—Studies of gas—solid equilibria Part I Pressure—temperature equilibria have been measured over a range 30° to 130° C. for (a) ten systems containing different amounts of benzene and ferric oxide gel; (b) eight smilar systems containing different amounts of benzene and silica gel. Pressure—concentration isothermals for benzene—ferric oxide gel systems and for benzene—silica gel systems are strikingly different in shape for these two closely analogous systems. The adsorptive processes of the two gels for condensible vapours are thus profoundly different, and doubt is cast on Zeigmondy's capillary theory as a general explanation for adsorption of condensible

vapours by inelastic gels.

# The Neanderthal Phase of Man.

N Tuesday, Nov. 8, the Huxley Memorial Lecture of the Royal Anthropological Institute was delivered in the lecture room of the Royal Society by Dr. Aleš Hrdlička, Curator of the Department of Physical Anthropology, U.S. National Museum, Washington, who took as his subject "The Neanderthal Phase in Man." For science, the subject of human evolution has long since passed from the realm of theory or hypothesis into that of well-substantiated facts. Many important details, however, of this most wonderful and promising of natural phenomena remain to be determined or settled. One of the foremost of these is the question of the Neanderthal stage of humanity, corresponding roughly to about the fourth fifth of the glacial time. From Huxley and Lyell to Sir Arthur Keith, Elliot Smith, Sollas, Marett, Burkitt, and Karl Pearson, all the noted English, besides a host of Continental and even American anthropologists, have given this stage of human prehistory their earnest attention, without being able to reach final conclusions. The chief cause of this has been the dearth of the skeletal remains of Neanderthal man. Even with repeated finds, material in good condition was insufficient for what is needed.

Notwithstanding this, the indications appeared to justify certain views, and these, formulated by men of high authority, were soon generally accepted. The chief of these was the opinion, fathered by the noted German anthropologist Schwalbe, that Neanderthal man was radically different from later man; that during or soon after the last maximum glaciation he was suddenly and completely displaced by a new

human species, *Homo supicus*, who came from some where outside, from the south or, more likely, from the east; and that he left no progeny

As time advances, however, ever more remains of

Neanderthal man come to light, and as the subject is studied more thoroughly, it appears that this older view is in need of a substantial revision. It is now known that no marked disturbance in habits (housing, food, etc.) between Neanderthal and later man can be determined. Neanderthal man occupied a great territory, comprising the larger part of Europe with northern Africa (at least) and western Asia, and nowhere is the higher type of man found to precede him or to live contemporaneously. Abruptly or even slowly to annihilate such an extensive population as that of the Neanderthalers would seem impossible. No separate home of Homo sapiens has been discovered; he does not appear with a higher culture. but gradually develops the latter. As his Neanderthal predecessor he knows fire, but no agriculture, no domestication of animals, not even a dog or a cat, makes no pottery, nor even the crudest of walls, and remains for a long time yet in the palacolithic stage of the stone industry Beyond which, the more the remains from the Neanderthal and the succeeding periods grow in number, the more there appear of transitional features; and this applies to both the archæological as well as the skeletal remains. is a growing series of Neanderthal skulls, and jaws that distinctly approach those of later man (i.e. Spy No. 2, Weimar, Gibraltar boy, etc.), and, on the other

hand, an ever-increasing number of later crania and

laws that approach the Neanderthal forms. Moreover, it is biologically certain that man in the course of his evolution must, at some time and somewhere, have passed through a more or less Neanderthal-like stage.

In view of all this, it appears progressively less safe to persist in regarding Neanderthal man as a separate species of man, and to close the door to the possibility of further human evolution from his midst. The indications are that before long science will be in a position to view the Neanderthal man and his culture as regular and inherent phases of human evolution

At the end of the lecture, the president of the Royal Anthropological Institute, Mr H J E. Peake, presented the Huxley Memorial Medal to Dr Hrdlička.

# University and Educational Intelligence.

CAMBRIDGE — Dr. P. M. Dirac has been elected to a fellowship at St. John's College. Mr. McLean, master of Christ's College, has been elected a member of the Council of the Senate.

Regulations have been proposed to the University for the newly founded Rouse Ball professorship of mathematics. It is not proposed to assign the new chair permanently to any one branch of mathematics, but if the General Board so decides at any election, it will be specified in the notice to candidates that preference will be given to those whose work is connected with some particular branch or branches of mathematics.

R. O. Redman, St. John's College, has been elected to an Isaac Newton studentship; J. A Gaunt, Trinity College, and S. Goldstein, St. John's College, have been elected to additional Isaac Newton studentships for one year.

The President of the Board of Education has appointed a Departmental Committee to inquire into the public system of education in Wales and Monmouthshire, in relation to the needs of rural areas, and to advise how those needs may best be met, having regard to the requirements (1) of a general education, (2) of rural industries, businesses, and professions; and (3) of life in a rural community. Sir John Eldon Bankes is chairman, and Mr. C. P. Clayton, Assistant Inspector, Welsh Department, Board of Education, is secretary to the Committee. All communications should be addressed to the secretary.

The Institution of Naval Architects is offering the Elgar Scholarship (£130 per annum) and the John Samuel White Scholarship (£100 per annum) in naval architecture for competition in 1928. These scholarships are tenable at the universities of Glasgow (four years), Durham (Armstrong College) and Liverpool (three years), and the Royal Naval College, Greenwich (three years) They are open to British apprentices or students who have not yet entered upon a university course Full particulars may be obtained from the Secretary, Institution of Naval Architects, 5 Adelphi Terrace, London, W C.2.

The calendar for 1927–28 of University College, London, now entering upon its one-hundredth session. is of exceptional interest, containing, as it does, a full record of the proceedings of the centenary celebrations. The College is remarkable alike for the range

of its work and for the unusually ample provision for advanced study and research. Of the 800 pages of the calendar a large number relate to post-graduation study, particulars being given of courses of advanced lectures in forty-three departments, including a series arranged by Prof. Wolf, with the co-operation of other professors and teachers of the University, on the history, principles, and methods of the sciences. There is a list of some 450 original papers published during the past twelve months in 37 departments, notably anatomy (52), physiology (53), chemistry (45), and history (45). The number of graduate and research students last year was 534.

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'INDUSTRIAL Administration' has been a subject of university study in Great Britain since 1918, when a group of business men promoted and largely financed a department in the Manchester Municipal College of Technology. In the prospectus of the College for 1927-28, particulars are given of a one-year post-graduate course covering the following ground: industrial output, purchasing and stock-control, economic history, history of industrial organisation, factory law, wage systems and factory costing, business statistics, industrial relationships. The Director of the Department, Dr. J. A. Bowie, in a recent address to a managers' association, defined his subject as the technique and problems of industrial management with special reference to the internal organisation of manufacturing concerns. The two great faults of British management to-day, he said, are secretiveness and an unwillingness to learn, and the remedy is to be found in requiring managers to study management before they attempt to practise it. He quoted Mr Hoover as having said that the enormous industrial progress of the United States is due mainly to the emphasis placed there on business education, and remarked that about a hundred American universities and colleges have schools or departments of business administration.

AT the League of Nations Assembly in September a report was presented on the work of the League's Committee on Intellectual Co-operation. The report directs special attention to the creation at the International Institute of Intellectual Co-operation of a co-ordination service of information offices attached to libraries, to the Committee's proposals for co-ordination between the organs of bibliography for the various sciences, to the need of funds for the maintenance of the Office for Annual Tables of Constants and Mathematical Quantities, and to the steps taken in preparation for the Popular Arts Congress (to be held at Prague in 1928), for an international agreement with regard to casts, and for promoting the extension of the educational work of museums It is also pointed out that additional funds are needed for the Institute, grants to which are at present made only by the following countries: Austria, Czechoslovakia, France, Hungary, Italy, Monaco, Poland, and Switzerland. The question how to protect and reward men of science and their discoveries by means of an international convention has been investigated during the past five years, and it is now thought that the matter is ripe for definite action. It is intended therefore to convene a committee of experts to prepare a draft convention. A separate report was submitted on the Italian proposal for the creation of an educational kinematographic This proposal looks to the creation at institute Rome of an institute under the direction of the League of Nations, but to be carried on at the expense of the Italian government.

# Calendar of Discovery and Invention.

November 20, 1817.—It was in 1743 that the Government first offered a reward for the discovery of a North-West Passage, and several attempts were made in the eighteenth century to find a passage. The resumption of such expeditions after the Napoleonic wars was largely due to the Royal Society, Sir Joseph Banks writing on Nov. 20, 1817, to Lord Melville "that discoveries may now be made . . not only interesting to the advancement of science, but also to the future intercourse of mankind and the commerce of distant nations." The outcome of the suggestion was the fitting out of the Isabella, Alexander, Dorothea, and Trent, respectively, under the command of Ross, Parry, Buchan, and Franklin

November 21, 1843.—Of the invention of vulcanised rubber patented by Thomas Hancock on Nov. 21, 1843, the inventor left a most interesting account in his "Personal narrative . . . of the India Rubber manufacture in England" (1857). Some time in 1842 his friend Brockedon gave Hancock some bits of rubber received from America which did not stiffen with cold. In his private laboratory at Stoke Newington, Hancock, groping "a good deal in the dark," ultimately discovered the changes brought about by mixing rubber and sulphur at various temperatures. Setting out to manufacture the new material on a large scale, he sought for a name, and it was Brockedon who suggested the term "Vulcanisation," which "owes its derivation to the Vulcan of mythology, as in some degree representing the employment of sulphur and heat, with which that mythological personage was supposed to be familiar."

November 22, 1675.—The first determination of the velocity of light was made by the Danish astronomer, Roemer, who, while engaged under Picard in Paris, studied the motion of Jupiter's satellites, and by observing their immersions and emersions found that light took about sixteen minutes to travel a distance equal to the diameter of the earth's orbit. This important result was communicated by him to the Paris Academy of Sciences on Nov. 22, 1675, and gained for him a seat in the Academy.

November 23, 1889.—In a letter to her daughter, dated Nov. 23, 1889, Mrs. King, the meee of Lord Kelvin, refers to Lord Kelvin's "meeting with the Admiralty, which was most satisfactory, for it is now ordained that his be the standard compass and be used throughout the Navy." There had, however, been attempts to prevent the adoption of the compass, approving letters having been pigeonholed. "I believe," says Mrs. King, "this had been going on for years, and that Admiral Fisher has been instrumental in exposing the abuse. . . There is much of the circumlocution office in the whole affair. Uncle William does not want it talked of . . ."

November 24, 1831.—In the course of ten days' work, spread over the months August to November, 1831, Faraday made his memorable discoveries in induced currents and magneto-electric induction. In his experiments he employed among other apparatus the famous iron ring, and the copper disc revolving between the poles of a permanent magnet now preserved in the Royal Institution. His results, amplified and extended, were presented to the Royal Society on Nov. 24, 1831. "So exhaustive was his treatment of the subject," said Prof. Fleming, "that no one has since added a single new fact or principle which is not implicitly contained in the record of this work thus given to the world."

November 26, 1725.—The discovery of the aberration of light by Bradley resulted from observations begun at Kew, Nov. 26, 1725. E. C. S.

#### Societies and Academies.

LONDON.

Royal Society, Nov. 10 —Sir Richard Paget. The origin of speech. (See Nature, July 9, p. 47.)

#### NUCLEAR PHYSICS

C. D Ellis and W A. Wooster. The average energy of disintegration of radium E. The average energy of disintegration of radium E is found by measuring the heating effect of a known amount of the material. It agrees with the mean energy of the continuous spectrum of electrons emitted from the nucleus, and the conclusion is drawn that the energy of disintegration is not a characteristic constant of a  $\beta$ -ray body but varies from atom to atom. From this result it appears that the  $\gamma$ -rays cannot be emitted by the electronic part of the nucleus but must have their

origin in the positive portion.

P. M. S. Blackett and E P. Hudson The elasticity of the collisions of alpha particles with hydrogen nuclei. Inelastic collisions involving the ejection of a proton from the nuclei of certain light elements are known to occur. They may also occur without, however, a proton being ejected; for example, the nuclei might be deformed without being disintegrated, or energy might be radiated by the rapidly accelerated This problem can be investigated directly by precise measurements of photographs of the collisions taken by the Wilson condensation method. The collisions of fast a-particles with hydrogen nuclei provide tracks which are susceptible of great accuracy of measurement and therefore would reveal any small energy loss should such occur If any loss of kinetic energy occurs it must be less (for the most favourable of the two tracks measured) than 1/200 of the initial energy of the  $\alpha$ -particle; less, therefore, than 40,000 electron volts If a quantum of radiation were emitted during the collision, its wave-length must be greater than 0.3 A.

#### SPECTRUM ANALYSIS.

E. T. S. Appleyard and H. W. B. Skinner. On the excitation of polarised light by electron impact. II.—Mercury. It has been shown that when spectrum lines are excited by a directed stream of electrons, they are variously polarised. Measurements of the polarisation by means of photographic photometry are now described. The most important feature of the curves obtained is the maximum value of the percentage polarisation which occurs when the energy of the electron stream exceeds the critical energy for excitation by a few volts. On the low-velocity side of the maximum, the polarisation falls very sharply, apparently to a zero value at the critical point. For high velocities, corresponding to 200 volts, the direction of the plane of polarisation is reversed. The results can be interpreted as a collision process in which an atom is excited by electron impact.

J. C. McLennan, H. Grayson-Smith, and W. T. Collins. Intensities in the secondary spectrum of hydrogen at various temperatures. The intensities of most of the lines measured by Merton and Barratt in the secondary spectrum of hydrogen have been measured by means of a microphotometer at two temperatures. For Richardson's series system the change of intensity with temperature is generally in good agreement with theory. The alteration of intensity between the odd and even members of the series is also clearly shown. Other regularities which have been found in the spectrum have also been examined, and from the change in intensity, many of these appear to be sequences of corresponding

members of different bands, rather than actual band series

B. Venkatesachar: Density of the vapour in the mercury arc and the relative intensities of the radiated spectral lines with special reference to the forbidden line 2270. The effect of lowering the density of the vapour on the series lines in the arc spectrum (includmg inter-combination lines) is to increase the absolute intensities of all lines below m=5 and diminish those of all lines above m=6. This result can be explained on the hypothesis that inelastic collisions between excited atoms in lower energy levels and thermally energetic normal atoms form the chief source of the radiators of the higher members of series lines. To the radiators of the lower members the contribution from this source is negligible. On increasing the vapour density, collisions between the radiators of the lower members and normal atoms resulting in radiationless transitions increase and the intensities of these lines fall – The forbidden line  $\lambda 2270$ , like the lower members of other series lines, increases in intensity when the arc passes to the low density

O. W. Richardson. On the intensity distribution among the lines of certain bands in the spectrum of the hydrogen molecule. The intensities of the lines of the Q branches of various bands of the hydrogen spectrum were examined critically, using the measurements of McLennan and his collaborators. The odd numbered lines are nearly three times as strong as the even numbered. The analysis shows that antisymmetric emitters are three times as numerous as symmetric. This holds for various vibration states of the 3-electron state and probably also for the 4 state. The ultra-violet spectrum data seem to require it to hold also for the 2 state, and Dennison's analysis of the specific heat of hydrogen requires it for the

l state

J. S. Foster · Application of quantum mechanics to the Stark effect in helium. New measurements of displacements of helium components in fields of 100,000 v./cm. and 83,000 v./cm. are recorded. The first-order displacements have been calculated at several field strengths for components of the line groups 2P - (4Q, 5Q), 2S - (4Q, 5Q) and for the corresponding orthohelium lines, considered as singlets. These displacements are in good agreement with observations at all field strengths. Approximate positions of the components at extremely high fields are calculated, and the manner in which certain components are expected to cross each other in moderate to high fields is described. In the case of two lines, at least (2P-4F, 2P-5G), there is conclusive experimental evidence of such crossing. In particular, the theory accounts satisfactorily for the observed disappearance of numerous components when the displacement is equal to that of the 2P-nP line at zero field.

R. W. Ditchburn: The continuous absorption of light in potassium vapour. The absorption found is believed to be due to a combination of molecular and atomic absorption. The results are discussed in connexion with the theory of atomic and molecular absorption; the amount of atomic absorption appears be much less than that expected. The heat of dissociation of the potassium molecule is derived from the absorption curves and used to calculate the degree of association in potassium vapour at different temperatures.

J. W Ryde: The spectrum of carbon-arcs in air at high current densities. The positive carbons were cored with metallic salts. Under suitable conditions, this allows steady arcs at high-current densities to be obtained. As the current through such arcs is in-

creased, a bright central core develops in the arc stream. In this core it was found that spectra of C I, N I, O I, together with the Balmer hydrogen lines and the strongest lines belonging to the red spectrum of argon, are excited. The relative intensities of C I and N I lines, previously only tound in special discharge tubes, are compared with those found in the arc stream. More than fifty new lines were observed. These also are probably due to either N I, O I, or C I.

#### TENSOR AND DIFFERENTIAL CALCULUS.

J L Burchnell and T W Chaundy: Commutative ordinary differential operators. Associated with any polynomial f(p,q) of a certain type is a group [P,Q] of pairs of commutative operators which also satisfy the identity f(P,Q)=0. The construction of these operators is based on the set of Abelian equations of the first kind associated with the polynomial f(p,q), the function  $\eta(p,q)$  which is annihilated by both P-p,Q-q is an Abelian function of the second kind. If P',Q' denote the operators adjoint to P,Q, then the group of adjoint pairs [P',Q'] can be derived from the group [P,Q] by change of sign of x, and in particular there is one pair in the group which can be derived from its adjoint in this way. If P,Q is a commutative pair, there are operators T such that we may write

 $\mathrm{TP} = \mathrm{P_1T}, \qquad \mathrm{TQ} = \mathrm{Q_1T},$ 

where  $P_1$ ,  $Q_1$  are other operators also commutative and obeying the same identity as P, Q

T. M. Cherry · Periodic solutions of Hamiltonian systems of differential equations. The existing theory (Pomcaré's) is unsuited to finding the mutual relations of the periodic solutions of a fourth order Hamiltonian system. Periodic solutions occur in general in continuous singly infinite families. With each solution of a family is correlated a number R which may be real or unreal and varies continuously along the family. From any solution S for which Ris real and rational there branch two (in general) new families, whose periods near S are approximately integral multiples of the period of S. A family for which R is real thus throws off branches at all its rational' members. These families, when real, are susceptible of a geometrical representation in which to each periodic solution corresponds a point, and to each family a line in 3-dimensional space. Taking the whole aggregate of such lines, they apparently join up so as to form a system of closed meshes of complicated character, only partly elucidated.

M. H. A Newman A gauge invariant tensor calculus A 'projective' differential calculus is developed, capable of dealing with tensors of various weights,' as well as tensors of various ranks. The equations preserve their form both under a change of co-ordinates and under a change of measure-system. The theory is applied to find a tensor and gauge-true form for the identities given by the variation of integrals. The general gauge-true equations resulting from the law

$$\delta \int \mathbf{R}^2 \sqrt{g} = \mathbf{O}.$$

are obtained. The part independent of the 'electrical' vector  $\phi_1$  is found to be

$$G_{ik} - \frac{1}{4}Gg_{ik}$$

a tensor which has been considered by Einstein from time to time in connexion with the theory of gravitation.

F. B. Pidduck: Adjoint differential equations · E. Bortolotti showed that adjoint differential equations have a certain analogy with sets of linear algebraical

equations in which rows and columns are interchanged in the matrix of coefficients. G. D. Bukhoff gave a rule for finding a set of adjoint boundary conditions which make the fundamental integral, or bilinear differential form, vanish when taken over the whole range. The present paper traces the appearance of the adjoint equation and boundary conditions when the number of unknowns in the linear equations tends to infinity.

(To be continued.)

Mineralogical Society, Nov. 1 (Anniversary Meeting)—L. J Spencer: (1) Specific gravities of minerals: an index of some recent determinations. Specific gravity as determined by heavy liquids affords a convenient first-aid in the determination of minerals. 2277 determined values collected from the recent mineralogical literature are arranged numerically, and an alphabetical index of mineral names gives the minimum and maximum values for each mineral.
(2) South African occurrences of willemite Fluorescence of willemite and some other zinc minerals in ultra-violet rays. Willemite is described from Broken Hill and two other localities in Northern Rhodesia where it appears to be of abundant occurrence, and from Guchab in South-West Africa. Unlike the willemite of Franklin Furnace, New Jersey, some of these not do fluoresce in ultra-violet rays. Fluorescence is not a constant and essential character of a mineral species, and it evidently depends on the presence of admixed impurities.—T. V. M. Rao. A study of bauxite. Specimens of laterite from India, Gold Coast, and other countries were described. It was shown that laterite is a rock largely composed of the mineral bauxite, which has a definite composition corresponding to the formula Al<sub>2</sub>O<sub>3</sub>, 2H<sub>2</sub>O. Details of an experiment to trace the process of laterisation in Nature were also given—P. K. Ghosh: On the biotite-bearing greenstones and on a rhyolitic pumice in the metamorphic aureole of the Falmouth grante. The biotite constituent, which has so far been ascribed to the inctamorphic action of the Armorican granite on the pre-existing greenstone, is proved to be the undigested and residual part of the slate fragments stoped by the 'greenstone' magma at the time of its intrusion. Rhyolitic pumice is noted for the first time in this region and its mineralogical characters are described.

Society of Public Analysts, Nov. 2.—Sir William Willcox: The biological tests for blood. An outline was given of the evolution of blood tests, from the days when the only differential method available was based on differences in the form and size of the blood corpuscles, down to the refined serum tests of the present time. Caution is necessary in using bought specific sera for these tests, since they were frequently mert.—G. Roche Lynch. The technique of the precipitin test and its forensic value. The various methods of preparing anti-sera, the extraction of blood stains, the filtration and sterilisation of the extract by means of special apparatus, the methods of determining the concentration of the extract, and the various ways in which the precipitin test can be applied were described.—F. C. Martley The use of the blood grouping reactions in forensic investigation. By means of the four blood groups into which the blood of different individuals can be classed, it is often possible to distinguish between the blood of different persons. The method has applications in forensic work and in determining paternity.

#### Paris.

Arademy of Sciences, Oct. 17.—A Lacroix: First observations on the mineralogical and chemical com-

position of the Mesozoic and Tertiary lavas of eastern China. The lithological types observed melude rhyolites, dacitoides, andesites, basalts, and limburgites. All the rocks which are not basaltic are very poor in coloured minerals and they all contain free silica.—F E. Fournier The horizontal resistance of water to the translation of hulls. - d'Arsonval. The heating of tissues by high-frequency currents. A description of experiments with the 'long chair,' in which the patient and a metallic plate form the plates of a large condenser. The body of the patient was replaced by a bottle containing salt solutions of varying concentrations, and the corresponding rises of temperature measured —Ch. Riquier: The numerical resolutions of systems of integral algebraical equations with any number of unknowns.-P. Vincensini: Congruences with mean plane surface.—
E. Lainé The partial differential equations of the second order of the form s=p(x, y, z, q) which are of the first class—Stefan Kempisty. The integral (A) of M. Denjoy.—Georges Alexits—The divergence of Fourier's series of continued functions.—N. Podtiaguine: Regular increasing functions.—Antomo Cabreira: Algebraical schemes of the dates of the lunar phases and the table of relative tides.—E. M. Antoniad:: The rotation of the planet Mercury. The observations described confirm the discovery of Schiaparelli, that the period of rotation of Mercury is equal to its period of revolution -G. W. Ritchey: A type of fixed vertical photographic telescope, with cœlostat, with interchangeable focal ratios.—Léon and Eugène Bloch: Spark spectra of higher order of sulphur and selenium. The sulphur (or selenium) was enclosed in an evacuated quartz tube, without electrodes, and excited by an oscillating discharge in a solenoid wound round the tube. Tables of the lines measured are given -W. Swietoslawski and Mlle. A. Dorabialska. An adiabatic microculorimeter for radiological researches. The microcalorimeter described and illustrated has a thermal capacity so low as 0.08 calories The instrument has been used to determine the heat evolved by 4.3 milligrams of radium, the rise of temperature found being 0° 0808 per hour. It has also been possible to measure the heat given off by the  $\alpha$ - and  $\beta$ -rays of one millicurie of radon contained in a capillary tube. Vasilesco Karpen: Batteries with unalterable identical electrodes—René Audubert. The valve effect presented by a silicon anode and its mechanism. A very efficient rectifier is produced by a cell with a silicon anode. it is shown that the effects produced are connected with an oxidation-reduction process.— Mlle. C. Chamié. The existence of groupings of atoms of radioactive elements in acid solutions and in surfaces activated by the emanation.-Jean Cournot and Jean Bary: The use of electrolytic deposits of cadmium for the protection of metals and alloys against corrosion. Cadmium plating is superior to nickel plating in being non-porous and consequently shows high resisting power to corrosion. On the other hand, the deposited cadmium is not so hard as nickel and soon loses its high polish Good results were obtained by cadmium and nickel together. Ed. Chauvenet and E. Duchemin: The combinations of zirconium oxychloride with the alkaline chloride. No thermal effect, and consequently no compound could be shown by mixing solutions of zirconium oxychloride (ZrOCl<sub>2</sub>) with lithium, sodium, or potassium chlorides On the other hand, definite compounds of zirconium oxychloride were proved with ammonium chloride, rubidium chloride, and cæsium chloride.-G. Denigès: Stable and unstable molybdenum blues. Analytical applications to the detection of phosphoric and arsenic ions. Details of the preparation of a

No. 3029, Vol. 120]

reagent for the detection and estimation of minute traces of phosphates -Amand Valeur and P. Gailliot . Study of the products of high boiling-point contained in oil of Cadet A new type of arsenic compound has been isolated containing three atoms of arsenic in the molecule; these bodies are chemically very stable. L. Joleaud. Contribution to the stratigraphical study of the Tertiary soils of the Caribbean regions of South American Colombia — Léon Moret The extension of the phosphate deposits in the Haut-Atlas of Marrakech (Western Morocco) - Jacques de Lapparent · The occurrence of dolomitic walls in bauxite deposits -Ch. Jacob: The structure of the Turbon, Cotiella, and Castillo-Mayor in Haut-Aragon.—A Maige marks concerning the greening of plant cells—Mile. Suzanne Ancel The action of time and intensity in the effect of irradiation by the X-rays on germinated seeds. Under the conditions of the experiments described, and for an equal dose of X-rays, the increase of time of irradiation with diminution of intensity shows a clear and constant diminution of the effect of the rays—R Franquet The formation of aerial tubercles of the Jerusalem artichoke without grafting —L Mercier · The presence of Chrysomyia albiceps on the coast of Calvados.—A Policard. Studies in microdissection on the cartilage of growth of bones.—R Fosse and A Hieulle. A mercuric compound of allantoic acid permitting the identification of this ureide in the green legume of Phaseolus vulgaris.

## Official Publications Received.

#### BRITISH.

Aeronautical Research Committee Reports and Memoranda No 1086 (Ae 2e5) Wind Tunnel Tests with High Tip Speed Airscrews The Characteristics of the Aerofoil Section R A F 31a at High Speeds. By Dr G P Douglas and W G A Perring (A 3 d Airscrews, 97.—T7. 2370) Pp 33+14 plates 1s 6d net No 1094 (E 25) A Discussion of the Law of Variation of Engine Power with Height. By H Glauert (B 4 Engines, 63—T 2427) Pp 7 4d net (London H M. Stationery Olinee)
University of Manchester Faculty of Technology Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1927–1928. Pp. 310 (Manchester.)
The Manchester Municipal College of Technology Prospectus of Courses in Industrial Administration, Session 1927–28 Pp 18. (Manchester)

Pp 18. (Manchester Industrial Administration, Session 1927-28 Pp 18. (Manchester)
Proceedings of the Cambridge Philosophical Society. Vol 28, Part 8, October. Pp. 845 1004+vi (Cambridge At the University Press) 78, 64 net

78.61 net
North East Coast Institution of Engineers and Shipbuilders Report of the Council, 1926-27 Pp 16 (Newcastle-upon-True)
Transactions of the Hull Geological Society Edited by Thos Sheppard Vol 7, Part 1, 1926-1927. Pp 10 (Hull: A Brown and Sons, Ltd.) 5s
Melayan Forest Records, No 4 Notes on Damar-Penak. By R. W Blair and Dr. F. E. Byron. Pp. 12. (Kuala Lumpur Forest Department) 50 cents, 1s.
Department of Agriculture, Ceylon, Bulletin No. 80 Experiments in Cacao Fermertation. By T. H. Holland. Pp 21. (Peradeniya.) 40 cents

cents
Ceylon Administration Reports for 1926. Part 4 Education, Science and Arts D) Administration Report of the Director of Agriculture for 1926 Pp D(P). (Colombo Government Record Office.) 1 45 rupees.
London School of Hygiene and Tropical Medicine. Third Annual Report to the Court of Governors, 1926-77. Pp. 12 (London.)
Journal of the Chemical Society containing Papers communicated to the Society. October. Pp. \(\mu \mu + \mu + \mu + 2389-2660\) (London Gurney and Jackson.)

Jackson.)
Acronautical Research Committee Reports and Memoranda No 1061 (Ac 214). The Distribution of Normal Pressures on a Prolate Spheroid. By Dr R Jones. (A 3 c. Airships-Experiments on Models, 83.—T. 2171.) Pp S7. 3s net. No. 1101 (Ac. 719) Full Scale Tests of a Bristol Fighter with Slot and Aileron Control operated by a Differential Link Mechanism. By H. M Garner. (A 2 b. Stability Full Scale Experiments, 53.) Pp 2+2 plates. 4d net (London H M Stationery Office.)
Scientific and Industrial Research Council of Alberta. Report No. 18 The Priminous Sands of Alberta. By K. A. Clark and S. M. Blair, Part if: Separation Pp v+36+3 plates. (Edmonton, Alba: W. D. MacLean.)

Part if: Separation Pp v+36+3 plates. (Edmonton, Aloa: w. D. MacLean.)

University College of North Wales Calendar for Session 1927-28. Pp 403. (Bangor)

Aeronautics Technical Report of the Aeronautical Research Committee for the year 1925-26 (with Appendices) General Aerodynamics (Aerodols, Stability and Control, Performance), Air screws, Engines, Materials, Strength of Structures, Instruments. Pp vin+1023+382 plates. (London H.M. Stationery Office.) 35s. net.

Iransactions of the Royal Society of Edinburgh Vol 55, Part 2, No 14 Contributions to the Study of the Old Red Sandstone Flora of Scotland Vi, On Zosterophyllum myectonucum, Penh, and some other Plaus Remains from the Carmyllie Beils of the Lower Old Red Sandstone; vi. On a Specime of Pseudosporochnus from the Stromness Beds. By Dr W H Lang Pp 448-455+2 plates 2s col Vol 55, Part 2, No 20, Geology of the Onter Hebrides Part iv South Hanns. By Dr T J. John and R. M Grag. Pp 457-488+5 plates 5s 6d (Edinburgh; Robert Giant and Son, London Williams and Norgate, Ltd)
Development Commission. Seventeenth Report of the Development Commissioners for the Year enued the 31st March 1027 Pp. 17s. (London: H M Stationery Office) 3s net. Colony and Protectorate of Kenya Forest Department Annual Report for the Year enued 31st December 1026 Pp 33. (Narrobi Government Press.) 1 net
Ceylon Administration Reports for 1026 Part 4 Education, Science and Art (F) Administration Report of the Government Marine Biologist for 1926 Pp F2) (Colombo Government Record Office) 05 cents

United States Department of Agriculture Department Bulletin No 1490 Detects in Timber classed by Insects By Thomas E Snyder. Pp 47 15 cents Department Circular 411 The Relation of Insects to Slash Disposal Pp 12 5 cents (Washington, D.C. Government Pinting Office)

Slash Disposal
Pp 12 5 cents (Washington, DC Government Printing Office)
Department of Commerce US Coast and Geodetic Survey Senial No 334 First-Order Leveling in Oreion By Henry G Avers (Special Publication No 122) Pp 78+2 plates. (Washington, D.C. Government Printing Office) 15 cents
Technical Books of 1925 a Selection Pp 28 (Brooklyn, NY Pratt Institute Free Library)
Bulletin of the American Museum of Natural History Vol 54, Art 5 Notes on Chinese Amphibians. By Karl Patterson Schmidt Pp 535-575+plates 31-32 (New York.)
Department of Commerce Bureau of Standards Scientific Papers of the Bureau of Standards, No 560: Density and Electrical Properties of the System, Rubber-Sulphur Part 1 Density of Rubber-Sulphur Compounds, by A T. McPherson, Part 2 Electrical Properties of Rubber-Sulphur Compounds, by H L Curtis, A T McPherson and A H Scott Pp 383-418 (Washington, DC . Government Printing Office) 15 cents
Journal of the Faculty of Science, Imperial University of Tokyo. Section 2 Geology, Mineralogy, Geography, Seismology. Vol 2, Part 3 Stratigraphical Studies of the Fusulina Limestone of Akasaka, Province of Mino By Prof Yoshiaki Ozawa Pp 14-12 Hol+plates 34-46 2 00 yen Vol 2, Part 4 Fossil Mollusca from Kaga, by Matajiro Yokoyama, Tertiary Fossils from Westein Hizen, by Matajiro Yokoyama Pp 165-204+plates 47-52 1 20 yen. Vol. 2, Part 5 On the Occurrence of Pulsatory Motions in the Earth's Clust By Takeo Matuzawa Pp 205-208 1 40 yen Section 3 Botany Vol 1, Part 5 On the Occurrence of Pulsatory Motions in the Earth's Clust By Takeo Matuzawa Pp 205-208 1 40 yen Section 3 Botany Vol 1, Part 5 On the Occurrence of Pulsatory Motions in the Earth's Clust By Takeo Matuzawa Pp 205-208 1 40 yen Section 3 Botany Vol 1, Part 5 On the Occurrence of Pulsatory Motions in the Earth's Clust By Takeo Matuzawa Pp 205-208 1 40 yen Section 3 Botany Vol 1, Part 5 On the Occurrence of Pulsatory Motions in the Earth's Clust By Takeo Matuzawa Pp 205-208 1 40 yen Col. Field of Hactoro, Teshoo, by Matajiro Yokoyama Pp 165-204+plates 47

Experimentelle zytologische Beitrage. Mittering 2002 des destillierten Wassers auf die, Wurzelspitzenzellen von Vieu Fula bei verscheidenen Temperaturen Von G. Yamaha. Pp. 215-246-plates 14-15 160 yen (Tokyo. Maruzen Co., Ltd., Berlin R. Friedlander und Sohn.)

Statens Meteonologisk-Hydrogiańska Anstalt Årsbok, S. 1420 5. Hydrografiska matningar i Sverige Pp. 40+5 planschering (Stockholm.) 500 km

Department of Commerce: U.S. Coast and Geodetic Survey. Special Publication No. 133. Progress of Work in Terrestrial Magnetism of the U.S. Coast and Geodetic Survey, January 1, 1925, to June 30, 1927. By N. H. Heck and D. L. Hazard. Pp. 8. (Washington, D. C. Government Printing Office.) 5 cents.

Meddelande fián Lunds. Astronomiska Observatorium. Sei. 2, Nr. 37. Investigations on the Stars in High Galactic Latitudes. 1. Colours and Magnitudes of 3700 Stars within 10° of the North Galactic Polis By K. G. Malinquist. Pp. 104. (Lund. C. W. K. Gleerup. Leipzig Otto Hariassowitz.)

Pioceedings of the United States National Museum. Vol. 71, Art. 18. The Geology, Petrography and Mineralogy of the Vicinity of Italian Mountain, Gunnison County, Colorado. By Whitman Cross and Earl V. Shannon. (No. 2040.) Pp. 42+2 plates. Vol. 72, Art. 21: A recently found Iron Meteorite from Oakley, Idaho. By Geoige P. Merrill. (No. 2048.) Pp. 32-2 plates. Vol. 72, Art. 3. New Species of Mollusks of the Genus Corbicula from Urugany and Brazil. By Williams B. Marshall. (No. 2060.) Pp. 7+1 plate Vol. 72, Art. 4. Herstofore undescribed Meteoric Irons from (1) Bohvia, South America, (2) Western Arkansas, and (3) Seneca Township, Michigan. By George. P. Merrill. (No. 2700.) Pp. 4+2 plates. Vol. 72, Art. 16. The Rodents of the Genus Plagiodontia. By Gerit S. Miller, Jr. (No. 2712.) Pp. 8+1 plate. (Washington, D. C. Government Printing Office.)

Bulletin of the Bingham Oceanographic Expedition of the Pawnee, 1927. Ceratioidea. By Albert Eide Parr. Pp. 34. (New York.)

Bulletin of the American Museum of Natural History. Vol. 57, Art. 1. On the Anatomy

On the Matchy and Classification of the weaver-Birds. By Feter F. Sushkin, Pp 32. (New York.)

U.S. Department of Agriculture, Farmers' Bulletin No 1548 The European Corn Borer, its Present Status and Methods of Control. By D J. Caffrey and L. H. Worthley Pp. 11+48 (Washington, D C Government Frinting Office.) 20 cents.

# CATALOGUES.

Catalogue of Books on the Subject of Entomology (No. 155.) Pp. 16 (London: Dulau and Co., Ltd) Catalogue of Interesting Works on Flowers, Shells, Insects and General Literature Pp. 8. (London: John H. Knowles, Balham)

## Diary of Societies.

FRIDAY, NOVEMBER 18

Association of Economic Biologists (at Imperial College of Science) (Botan) Department), at 2 15 — Foot and Mouth Disease — F C Minett History, Foot and Mouth Disease in Farm Animals, Disinfection — Dr A Arkwight Eyperimental Foot and Mouth Disease in Small Animals, General Characters of the Virus, Immunity — Dr S P Bedson Physical Properties of the Virus, Filtration, etc., Prophylactic Vaccines — Mrs. Y M. Burbury Survival of the Virus Outside the Body — I A Galloway Demonstration of the Lesions of Foot and Mouth Disease in Guine. Mouth Disease in Guinea-Pigs

#### SATURDAY, NOVEMBER 19.

BRITISH MYCOLOGICAL SOCIETY (at University College), at 11—S F Ashby The Oospores of Phytophthma nuovianu, with Notes on the Taxonomy of P proasitica—B. F Barnes On the Production of Variations in Eurotium—S Garside. Method of Reproduction in Sipualia tubularis—R M. Nattrass The Physiological Nomenclature Patricul Company. Editorial Comments

Editorial Comments
Institute of British Foundrymen (Lancashire Branch—Junior Section
(in Manchester University), at 3—Prof F C Thompson Addiess
ROYAL INSTITUTION OF GREAT BRITAIN, at 3—G. Holst. Samuel
Wesley and Robert Pearsall (I)
HULL Association of Engineers (at Municipal Technical College, Hull)
at 7 15—Prof. G Stoney: Modern Practice in Steam Turbines.

#### MONDAY, NOVEMBER 21

MONDAY, NOVEMBER 21

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 630.—G K. Wood. The Locomotive Boiler in Service

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7—W Day and others Discussion on Automatic Telephony

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8—Sin Heibert Baker: The Government Offices of Pretoria and the New Delh

ROYAL SOCIETY OF ARTS, at 8—Prof H C H. Carpenter Alloy Steels, their Manifacture, Properties, and Uses (Cantor Lectures) (II)

ROYAL GEOGRAPHICAL SOCIETY (at Eolian Hall), at 830—Major R E. Cheesman: The Blue Nile.

CHEMICAL INDUSTRY CLUB.

CHEMICAL INDUSTRY CLUB.

#### TUESDAY, NOVEMBER 22.

TUESDAY, NOVEMBER 22.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15—SII William Bragg: A Year's Work in X-Ray-Crystal Analysis (I.)

ILLLMINATING EMINEERING SOCIETY (at E.L.M.A. Lighting Service Bureau, II Savoy Street, W.C.2), at 7.—L. Gaster Report of Progress during the Vacation—Report of Committee on Progress in Electric Lamps and Lighting Appliances—H. Talbot Progress in Gas Lighting—at 8.15—Enhibition of Recent Lighting Appliances.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group), at 7—F. G. Newmarch Some of my Enperiences in Colour Work Institution of Engineering And Shipbullers in Scotland (at 39 Elmbank Crescent, Glasgow), at 7.30.—C. H. Faris. The Uses of Nickel Deposits for Engineering Purposes

Society of Glass Technology (at Congregational Schoolroom, Stourbridge), at 7.30—Plot W. E. S. Turner: Modern Artistic Glass (Lecture).

Institution of Automobile Engineers (jointly with Institute of Trans-

Institution of Automobile Engineers (jointly with Institute of Transport) (at Institution of Electrical Engineers), at 8.—Capt. C. H. Kuhne: Military Transport Vehicles: Recent Development and their Commercial Significance.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 830.—The Misses French.

Where the Great Wall Ends.

#### WEDNESDAY, NOVEMBER 23

WEDNESDAY, NOVEMBER 23

INSTITUTE OF FUEL (Annual Meeting) (at Institution of Electrical Engineers), at 10 30 A M

FARADAY SOCIETY (at Chemical Society), at 2 30—General Discussion on Cohesion and Belated Problems—Introductory Survey by Prof. C. H. Desch, and Papers by the following—N K Adam, H J. Gough, A. A. Griffith, Prof B. P Haigh, Sir W. B. Hardy, Prof. A. Joffe, Prof. J. E. Lennard Jones, Prof M Polanyi, Prof. A. W. Porter, F. I G. Rawlins, Prof G. Sachs, A M Taylor, Prof. G. I. Taylor. Society of Glass Technology (at Talbot Hotel, Stourbridge), at 2 30.—M H. Edwards: Fire Clays as applied to the Glass Industry—Prof. W. E. S. Turner Glass Pot Manufacture in Great Britain.—Mis G. A. Green (Edith M. Firth) and Prof W. E. S. Turner: The Homogeneity of Glass Melted in Pot.—Dr. S. English, H. W. Howes, and Prof. W. E. S. Turner: The Effect of Iron Ovide on the Properties of Glass.

of Glass.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. D. Fordyce: The Prevention of Heart Disease.

ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5—Dr E. Obermer. The Endocrinology of Tuberculosis.

ROYAL SOCIETY OF MEDICINE (Balneology Section), at 5 30—Dr L. C. E. Calthrop. The Scientific Basis of the Practice of Medical Hydrology (Presidential Address).

(Presidential Address).

INSTITUTION OF AUTOMOBILE ENGINEERS (North of England Centre) (at Engineers' Club, Manchester), at 7.—H. B Taylor' High-Speed Compression-Ignition Engine Research.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Institution of Mechanical Engineers), at 745—H L. Horquing. The Trend of Design in Motor Trucks and Motor Coaches for Fleet Operation

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—M. S. Bliggs: The

Architect (Lecture)

ROYAL SCRIETY OF ARTS, at 8.—T. H. Barry: Malayan Varnish Resins.

ROLAL AERONAUTICAL SOCIETY (Manchester Branch) (jointly with Manchester Branch of Institution of Aeronautical Engineers)—H B Taylor The Design and Development of the Compression-Ignition Engine

THURSDAY, NOVEMBER 24

INSTITUTE OF FULL (Annual Meeting) (at Institution of Electrical En-

INSITUTE OF FIEL (Annual Meeting) (at Institution of Entertial Engineer), at 10 50 a m.

BLECTRICAL ASSOCIATION FOR WOMEN (at 155 Regent Street, W), at 3—
The Value of a Refrigerator in Winter (Lecture)

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15—D1 R E. M. Wheeler

London before the Norman Conquest (II)

ROYAL AERONAUTICAL SOCIETY, at 6 30—Major C J Stewart: Modern

Developments in Aircraft Instituments

CHEMICAL SOCIETY, at 8—Prof W A Bone Gaseous Combustion at

High Pressures (Lecture).

High Pressures (Lecture).

ROYAL SOCIETY OF MEDICINE (Disease in Children, Therapeutics, and Urology Sections), at 830—Special Discussion on The Treatment of Pyuria in Children

Medico-Lecal Society (at 11 Chandos Street, W), at 830—Capt.

N Parkes A Case of Pathological Diunkenness as a Defence of Insanity at a Murdei Trial

as a Murder Trial
Society of Chamical Industry (Birmingham and Midland Section) (at
Chamber of Commerce Buildings, Birmingham) —A R Warnes Notes
on the Chemistry and Physics of Stone Decay
INSTITUTION OF THE RUBBER INDUSTRY (Manchester Section) (at Assembly
Rooms, Blackiriars House, Manchester) —Major A B. Shearer Attificial Silk and its Use in the Rubber Trade and Possible Lines of
Development. Development.

#### FRIDAY, NOVEMBER 25.

PHYSICAL SOCIETY (at Imperial College of Science), at 5—A E. Knowler .

The Electrical Resistance of Porous Materials —K Kichlu . Regularities in the Spectrum of Ionised Neon —Dr Ezer Griffiths A Calorimeter for the Measurement of the Heat Developed by Fruit — Demonstration of Lantern Sindes Connected with the Storage of Fruit. Instruction of Electracial Engineers (London Students' Section), at 6 15—G. H. Wilson Sources of Illumination

Manchester Literary and Philosophical Society (Chemical Section) (at Manchester), at 7.

MANGESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section) (at Manchester), at 7.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 7.30—L Andrews Elutriation as an Aid to Engineering Inspection Junior Institution of Engineering Inspection Ploneers in High Pressure Steam.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8—Dr E H R Hairies: Immunity in the Making

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall)—J E Hust Centrifugal Castings for Diesel Engines

Oxford University Junior Scientific Club—Dr A J. Gardner Lecture

SATURDAY, NOVEMBER 26

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—G. Holst. Samuel Wesley and Robert Pearsall (II ).

#### PUBLIC LECTURES.

SATURDAY, NOVEMBER 19.

HORNIMAN MUSEUM (Forest Hill), at 3 30 - H. N. Milligan . Common Mistakes about Evolution.

#### MONDAY, NOVEMBLE 21

GOLDSMITHS' HALL (Foster Lane, E C 2), at 4 -Very Rev. Doan Inge. Scientific Ethics (Norman Lockyer Lecture). UNIVERSITY OF LEEDS, at 5 15 -Dr R A. Fisher: Mathematics and Theories of Evolution.

King's College, at 5 30 - Prof. Doris Livingston Mackinnon Through a Glass Darkly

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7—Prof R. G Stapledon The Growing of Pedigree Strains of Grasses and Clovers for Seed

# TUESDAY, November 22

ROYAL SOCIETY OF ARTS, at 8 15 - Major H Baines The History of Housing: Housing 1885 to 1027 (Chadwick Lecture)

## WEDNESDAY, November 23.

TECHNOLOGY, AT 530.—E Salter Davies. Secondary Education Technical Institutes, Evening Schools, and Day Continuation Schools. UNIVERSITY COLLEGE, at 530.—C O G. Douie: The Report of the Departmental Committee on Libraries London School of Economics, at 6.—H Coleman. Office Machinery. The Numeralpha Filing System and the Roneodev Visible Index System.

#### THURSDAY, NOVEMBER 24.

CHARING CROSS HOSPITAL, at 3 .- Sir Aichibald Gariod Recent Advances in Science in relation to Medicine and Surgery (Huxley Lecture).

#### FRIDAY, NOVEMBER 25.

KING'S COLLEGE at 5 30 -C. J Gadd The Beginnings of the City of Ur.

#### S\_1TURD\_1Y, NOVEMBER 26

HORNIMAN MUSEUM (Forest Hill), at 3 30 .- J. E S. Dallas Nature in the Alps

#### CONGRESS.

Journées Médicales d'Egypte (at Cairo).



# SATURDAY, NOVEMBER 26, 1927.

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No. 3030, Vol. 120]

## The Influence of Science on Ethics.1

N his Norman Lockyei lecture, delivered on Nov 21 under the auspices of the British Science Guild, Dean Inge discussed the effect which the advance of scientific knowledge has exercised upon our modern notions of morality and our ideals of practical conduct. It is difficult in a discussion of this sort to separate religion from ethics, for in practice they are closely intertwined, and the influence of scientific conceptions has perhaps been greater upon religious thought than upon moral tendencies. Science reveals a world incomparably vaster than was dreamed of in the days when the great religions were founded has relegated man and his works to a re- wite and obscure corner of the cosmos, rollbing him end. proud position which he arrogated to him self a to centre and crown of creation. Selence has, in a fore, profoundly modified religions and are Has it had an equal effect upor more seems to us that the effect has been mainly :. acting through the changed conceptions . cosmos which science has imposed, and Dear Ing. remarks appear in general to support this view.

Dean Inge discusses first the problem so clearly stated by Huxley in his famous Rom - Lecture Huxley considered that the ethical proc. counter to the cosmical process, that the muiai life must be a constant fight against the lower instincts and desires which man has inherited from his animal ancestors. Law and morals he considered to be necessary restraints upon the struggle for existence between men in society, and his final conclusion was that "the cosmos works through the lower nature of man, not for righteousness, but against it." Being a man of fine and strong character, and in many ways a typical Victorian, Huxley laid immense stress upon righteousnessupon honesty and courage in thought and action and the paramount claims of duty. He was over impressed by the Victorian conception of Nature as red in tooth and claw, of life as a bitter struggle in which the prizes go to the strong and ruthless The opposition which he set up between moral Victorian man in societies, and prodigal, careless, and cruel Nature, seems to us now too rigidly drawn. After all, man also, with all his finer desires and aptitudes, his creativeness in art and science and philosophy, is a part of Nature; and, on the other hand, some of the despised lower instincts which he shares with the rest of the animal

<sup>1</sup> Scientific Ethics By the Very Rev Dean Ingo (British Science Guild, 6 John Street, Adelphi, London, W C.2) 18.

world are the basis of courage and self-sacrifice in man himself as well as in the lower animals. Protection of mate and offspring and sacrifice of self on their behalf are developments of the fundamental instinct of reproduction which is as powerful in man as in the lower animals.

Dean Inge describes Huxley's position as one of radical pessimism, and he is far from sharing it He does not think that we are forced to consider the universe as radically unfriendly. The main error of the Huxleyan view was that it considered the cosmic process apart from man. To do this is to despiritualise Nature

"The cosmic process," says Dean Inge, "is responsible for man as he is, with all his unselfish devotion to family, friends, and country, and all his pity and sympathy with the weak, all his idealism and belief in the unseen, as well as for those brute-instincts, which Read thinks are too often forgotten by moralists and reformers. We

t committed to anything so hopeless as a gainst the cosmic process."

to the positive contributions which the atific spirit makes to ethics, Dean Inge finds nese mainly in the influence exerted by the increased clarity and honesty of thought which are the result of free and unbiassed inquiry into the nature of things. Thus he thinks that we may expect to see a more exacting standard of accuracy in forming and expressing opinions Signs of this influence of the scientific spirit are already to be seen even in theological controversy, where "in those churches which are affected by the scientific conscience, there is much less garbling of facts and vilification of opponents than there used to be." Science will help too in driving out superstition and the baser forms of supernaturalism. "Perhaps nothing has corrupted the Christian religion so profoundly as the unethical magic which in many different forms has pervaded it: and it all rests on this assumption that there is a 'supernatural order,' which from time to time 'suspends' the laws of Nature, breaking the natural sequence of cause and effect." True religion, sound ethics, and the spirit of science can make common cause in resisting such beliefs. So, too, though science has nothing directly to do with theology, it may do good service by showing the inadequacy and poverty of the cruder conceptions of God which have done more harm to religion and ethics than the assaults of dogmatic atheism.

An interesting question is raised by Dean Inge's clause that the proof of our blood-relationship with the other-animals supplied by the doctrine of evolution has led to a more humane treatment of

animals In countries where the Church has firmly resisted the evolutionary doctrine, animals are: a rule cruelly treated. No doubt there is truth this view, but it does not seem to us the whole truth, for there have been in all parts of the world lovers of animals and kindly masters long before evolution was dreamt of We hope, with Dean Inge, that the influence of science, and certainly of scientific men, will be exerted against the wanton destruction of plant and animal life and against the ugliness which seems inseparable from a mechanical civilisation, but we feel that the driving force must come not so much from the spirit of intellectual inquiry as from æsthetic and moral feeling

Dean Inge devoted an important part of his lecture to a consideration and advocacy of the eugenist position It is here that the direct influence of scientific thought and of the results of scientific inquiry upon conduct and practice, and even upon political action, is most fully exerted. A very definite ethical problem is raised, which gives rise to much conflict of opinion Science has shown the importance of taking long views, of providing for the future improvement of the race, and avoiding racial deterioration. Instancing the action taken by America in drastically limiting the immigration of inferior stocks, Dean Inge points out how profoundly this scientific point of view is beginning to affect practical morality and the conduct of human life. We do not propose t enter into a discussion of the eugenist case, on which there is much to be said both for and against, bu we confess to some surprise in finding Dean Ing stoutly maintaining that the new eugenic morali is more Christian than the moral traditions of t' pre-scientific age. This does not seem to us to! fully reconcilable with his own remarks quet above about man and the cosmic process, will pity and sympathy for the weak are rightly rank among the higher instructs of man.

Has the over elaborate civilisation which is to product in the main of the scientific age really to an increase of happiness or enhanced the dignit and value of the individual life? This is a important question which is dealt with in the concluding sections of the lecture. The mechanition of human life has proceeded apace. "Civilition—the accumulation of experience and of took seems to have brought intrinsic evolution to an endem of the slave is only half a man. Is there any cure for this state of things, any means by which man migh recover his lost opportunities for a full and rounded existence? And can science help towards this end?

"It seems to me," says Dean Inge, "that science 'ght to advocate a return to much simpler conons A happy and healthy country would be Ar bited—much more sparsely than England is at resent—by a population mainly agricultural, with small towns well supplied with schools, colleges, and laboratories. The passion for production at all costs would die a natural death, since the market for standardised products, now artificially stimulated by all the arts of scientific advertising, would be comparatively small. There would not be much of mere drudgery, for we should still have our labour-saving machines; but the arts and crafts would not be strangled and exterminated as they often are now The instinct of acquisitiveness has become a positive disease; it should be checked by the principle already enunciated, that no needs should be indulged beyond their biological justification. No one should be condemned to the ceaseless repetition of one simple act as his life's work, the human frame and nervous system are not adapted to such unrelieved monotony. It is the dullness and irritation of mechanical labour that drive men to alcohol, gambling, and Bolshevism."

A rational simplification, such as is here suggested, of the present absurdly complicated and cumbrous organisation which we call civilisation is needed to give mankind scope to develop its powers—some portion as men of science and philosophers, others as craftsmen and artists, and others again as good citizens and helpers of their fellow-men

# Sins of the Spirit. <sup>3n</sup>he Clash of Culture and the Contact of Races: an

Anthropological and Psychological Study of the Laws of Racial Adaptability, with special reference O to the Depopulation of the Pacific and the Govern-N ment of Subject Races. By George Henry Lane-Fox Pitt-Rivers. Pp. xiv + 312. (Londor.: teorge Routledge and Sons, Ltd., 1927.) 18s 10-4. CHORTLY after the War, Capt. Pitt-Rivers took a course at Oxford in psychological and anthropological studies. Thus equipped, and unleterred by the fact that he would be re-traversing the field of research in which had laboured the late W. H. R Rivers, one of the most brilliant of twentieth-century psychologists and anthropologists, he embarked for the South Pacific islands to undertake a further inquiry into the effect of the impact of alien peoples upon the indigenous tribes. The fruit of his researches is presented in this volume, which bears comparison with those of his famous predecessor for breadth treatment of subject matter, and exceeds them its clarity of expression and fearlessness of position. Capt. Pitt-Rivers's diagnosis of the implaint from which the primitive communities No. 3030, Vol. 120]

m Oceania are suffering, and his general conclusions regarding the effects of European exploitation and later well-intentioned British administration, are much the same as those of other objective observers; yet he achieves such novelty of treatment that his book must be read

There is a growing tendency among humanitarians in Europe and America to assume that 'native problems,' that is to say, native unrest and discontent, exist only in those territories where the native races are being dispossessed of their lands and exploited in the interests of white plantation owners and mining companies would reject the idea as preposterous that such exploitation, however cruel, may be less disastrous in its effects upon native morale than an intentionally benign administration or Christian missions. Such implicit faith have they in the perfection of our civil and religious institutions, so comments are they of the uplifting' influence of the conventional codes of their own society in introduced among primitive peoples, the large are are to ignore the possibility that there of the matrixes which are being catastrophically destroyed may be intrinsically more valuable to and more consonat with the natural development of native end " It may shake their secapiacency to "nowhere in the Pacific is the phendisappearance of the aboriginal ranable than in the islands of the Eiwhere Eur pean control I. a ... influence felt. In these Islands ecline, even during the last tween is well known and be attributed admitted official "nnot be attributed to "violence and s" , and civilised drink and diseases," to the disease Lord Olivier alleges he decrease of here population is due. These, of course, are in which cannot be disregarded, 'a 's there's doubt, avers Capt. Pitt-Rivers, apal cause in certain parts of the th. destruction of the "old-culture forms and en conmental conditions in the endeavour to impose too dissimilar a culture upon a people specialised by a long process of adaptation to particular conditions."

If there is one quality which differentiates the genume scientific worker from the rest of his fellows, it is his humility of approach to the problems which confront him. When an anthropologist, for example, studies native problems, the existence of differences between tribes and the manifest differences between races do not lead him hastily to assume that one particular culture form is superior to the rest and that it is in the best

interests of all peoples that they should conform to that one. As Pitt-Rivers says, "He studies native customs to discover their importance in relation to the social organisation of the people, and thereby discover what is essential to that organisation and the communal life of the tribe or race: to study their beliefs and their morality sympathetically in terms of their own thought, and without the desire to substitute for what is native something that is not native or adapted to native life."

There are certain aspects of the social life of most of the communities over which we exercise tutelage which shock the average European Nakedness and pre-nuptial licence, polygyny, consangumeous marriages, child-marriages, infanticide, are direct contradictions of our code of conventions Consequently, when confronted with racial degeneracy and depopulation, we attribute them to such 'evil' customs But, as Pitt-Rivers points out, these customs existed centuries before the advent of the Europeans, and apparently had no lethal effects. If the imposition of our conventions upon native communities, the introduction of our legal system, disciplinary, sanitary, and clinical measures, and our form of religion, are to be regarded as beneficial, there should be an increase of population. The hard fact is that in Oceania there is an obvious decrease.

This decrease supplies the author with his thesis—the lethal effects of culture-clash—and leads him to subject the native customs to searching analyses, more particularly those customs which we deem to be shocking. He defends polygamy and consangumeous marriages and discounts the idea that child-marriages and infanticide are intrinsically bad or lethal in effect among the communities where they are practised. Inbreeding, as he says, and quotes Westermarck in substantiation, has from the earliest historical times been practised most among kingly and chiefly castes, with the aim of maintaining the purity of blood of the ruling castes. Provided there is some motive and ideal of selection in mating, inbreeding is positively beneficial and not the reverse. Dealing with the effect of the Christian missionary, he says, "His first efforts are directed towards inculcating decency and modesty by creating a sense of shame. In other words, by inculcating flesh-consciousness and the virtue of concealment, the two sign-posts of Christian culture"

The later chapters of the book embrace a good deal that is of more general interest than specific application to the Polynesians. Nevertheless, they

will repay the most careful study even thou we may not be prepared to accept some of 'conclusions. The author has brought to the strong of 'psychological factors' a fresh mind. challenges the latest work of Spearman on "The Abilities of Man" with no little skill. On the subject of extrovert and introvert types he is most illuminating. But best of all is his scornful denunciation of Puritan intolerance and its narrowing and retarding effects on European culture.

Capt Pitt-Rivers is least convincing when dealing with sex-ratio, where he argues from insufficient biological foundation. Some of the statistics he quotes upon which he builds his theory are inadequate to the purpose. Occasionally also he makes sweeping generalisations which are not applicable to every primitive community. With certain parts of West Africa in mind, where the tendency is for the peoples to live in enormous towns, we cannot agree that "it is acknowledged that the tendency of native races of barbaric cultures is towards decentralisation." Again, some of us cannot share his views with regard to a "White Australia." The experiment in white colonisation in Queensland appears to have been most successful so far.

The publication of this volume can do nothing but good. It will shock the susceptibilities of many. That is an advantage. Anything which will arouse our colonial administrators from too smug complacency, anything which will persuade the Home authorities to select men for the Colonial service who have been trained to seek for knowledge, to regard the customs of the native peoples whose interests they should serve as an integral part of their culture and one of the greatest factors in determining their will to live, should be heartily welcomed not only by anthropologists but also by all other scientific workers.

If a suggestion to the author may be made, it is that he should now carry out similar researches in Africa. They are badly needed.

A G. CHURCH.

#### Modern Acoustics.

Sound: a Physical Text-Book By Dr. E († Richardson Pp. vii + 286 (London . Edward Arnold and Co , 1927) 15s net

O long as sound forms the most rapid means of communicating thought from one norms human being to another, the subject of acoustic cannot fail to be important. Nevertheless, after the

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ime of the publication of the classical treatises of elmholtz and Rayleigh, it received little attention thav problems and raised many difficulties in the practical application of the older knowledge. A dreary feature of the pre-War text-books on the subject was the neglect of researches carried out after about 1890. It is therefore a great pleasure to find that Dr. Richardson's book is a wellbalanced account of the present state of knowledge in experimental acoustics rather than still another of what may be called the Rayleigh-without-tears type of book. We must not complain that in this volume there is too little of Rayleigh, that is, too little mathematical treatment, for the sub-title is "A Physical Text-Book." The author claims that it covers all that a candidate for the pass and honours degree examinations of British and American universities should need In actual practice the English degree student can omit the subject of acoustics, and even if the subject is not omitted altogether there is not time for a full treatment such as is here given. The student needs rather a short book dealing with a few of the main topics together with laboratory experiments and problems for solution. Neither of the two latter are given in this volume

The book is more likely to be of service to the research student, the research worker, and the technician, as it is the only source of information in English of the results so far attained in any branch of the subject, together with copious references to the original papers. Since almost all the important work has been included, it is of interest to note the many problems which are still unsolved, due partly to the neglect of acoustics as a field of research. A fallacy exists in the minds of many physicists that in order to research successfully in this subject one must possess a 'musical ear.' When we see how such a genius as Helmholtz was misled by trusting to his ears, we cannot but wish that much acoustical research would be done by deaf workers, who would be almost compelled to attempt only quantitative measurements. In truth, the ear is not a scientific instrument, although it is a wonderfully sensitive apparatus, the powers of which are well summarised in the chapter on subjective sound. Much remains to be elucidated in the subjects of speech and of hearing.

Another big unsolved problem is that of sound recording. The ease with which one can set up a light membrane, and by coupling it with a suitable optical system, obtain pleasing curves upon photographic films, has misled many workers into

thinking that the curves represent the impinging sound waves Dr. Richardson rightly concludes that the phonodeik is the most accurate sound recorder of the phonograph type, but even this wonderfully delicate instrument was calibrated by a set of organ-pipes, and it was recently stated that at the National Physical Laboratory the organ-pipe as a standard source of sound had to be abandoned. The author shows kindness in omitting to mention one big memoir describing work in which gramophone records were used to study sound waves, and in which the method was fallaciously claimed to be good because by playing the record upon a gramophone and listening to it one could tell how nearly the indentations of the record represented the actual sounds originally recorded. It is safe to say that present we have neither a perfect recording ir ment nor a trustworthy standard source with the to test our imperfect instruments. Such as the later are well described in the chapter and vs. a sound in air. One should have like a fuller treasment of the condenser micropanae, in tailing that of H. Riegger, which differ, considerably from the Wente type mentioned An adequate treatment would have required a good deal of space, it is subject is important. It dis projectiess amonification. would have many value be applications

Electrical devices in general have aboutly been of great service in acoustical research. The best attempts described in the book at a plute energy men, arements which are no diff. It because of the not the absorpte value of the energy of a sound w ... A normal intercity, are repend upon electrical dev. . . In almost every chapter occur references to the use of electrical instruments such as the electro-magnet and the valve for maintaining the vibrations of uning-forks, diaphragms, bars and strings, the oscillograph, the Einthoven string galvanometer, the stroboscope, the piezo-electric oscillator and instruments depending on the change in the electrical resistance of a heated wire over which sound waves pass. As in so many other branches of physics, photography also has given much help, particularly in the recording of vibration and in the instantaneous spark photography of density changes in vibrating gases.

Special chapters are devoted to heat-maintained sounds and to æolian tones, the latter chapter wisely preceded by a discussion of vortex formation and Prandtl's work on viscous fluids. This had not previously found its way into the text-books of physics, despite the test of twenty years' successful application in aeronautics

Well-written sections dealing with the various

musical instruments are included. It might perhaps be better to omit such chapters from physical text-books, as their interest is more restricted than other branches of acoustics and their inclusion helps to spread the fallacy that acoustics is a subject for the musical physicist only. such the meagre information available is merely a source of irritation. Because we have a good deal of knowledge of the motions of bowed and struck strings, we must not assume that we understand the acoustics of the violin or the pianoforte. A gut violin string radiates none of its energy to the air, and a steel piano string radiates but little. There are many complex changes between the string and the listener's ear The problem of the special properties of a good Strad violin still defeats us. Le strings clearly do not hold the secret, for they are the same as are used upon any violin. Musical acoustics is best to intimate mixture of physics, p si \_\_ology.

The book dable, is well produced, and can be heartily mended to all interested in the surface. Technical haders and little or no mathems knowledge are 1green of difficulty in follow, almost the whole inerconnaise treatment. The honos degree sturistical treatments of Lamb or kindall ("Vibrating Systems and Sound," 1927), was to the research worker will need also Auerbach's "All stacs," 1907, and the eighth volume "Akustice" on the Geiger and Scheele "Handbuch der Physik" 192.

W. H GEORGE.

# A Canine Encyclopædia.

Dogs: their History and Development. By Edward C. Ash. Vol. 1. Pp xviii+384+108 plates. Vol. 2. Pp. xvi + 385-778 + plates 109-160. (London: Ernest Benn, Ltd, 1927.) 105s. net; edition de luxe, 252s. net.

In these two bulky volumes, Mr. Ash has for the most part succeeded in tracing the histories of practically all the domesticated varieties of dogs which are known at the present day. In an opening chapter on the origin and evolution of dogs as a whole, in which he quotes many well-known authorities, he puts aside Mivart's wolf-jackal ancestry theory in favour of a hypothesis that the ancestors of modern dogs probably existed in Eocene and Miocene times and were closely related to Cynodictus, Amphicyon, Simicyon, and Cynodesmus. It would seem, however, that in view of the rapidity with which change takes place in animals under domestication and artificial selec-

tion, there is no necessity to go back very fa<sup>2</sup>7 beyond historic times to find the ancestor of the modern dog, in all its variations, among the wolves and jackals, especially when one considers, as Mr. Ash points out later on in his second volume, that breeds so different as the Yorkshire, the Airedale, and bull terrier have all been 'made' during the past hundred years, and that the so-called Alsatian wolf-hound, more properly known as the German sheepdog, has only been in existence a little more than a quarter of a century.

Again, a comparison of some of the figures of typical dogs of a hundred years ago with those of their modern representatives shows that the type in many cases has changed to such a marked degree that the two might easily represent entirely different breeds. On the contrary, where the type became stabilised many years ago and artificial selection has been carefully carried on by man, as in the case of some of the members of the greyhound group, which are one of the oldest of all breeds, there appears to have been very little change in general appearance between the dogs of to-day and those of 6000 years ago

In view of the publicity which has been given to Alsatians in the daily press of late, it is interesting to note that Mr Ash says: "There seems to me to be little doubt that the Alsatian type was obtained or developed at some distant time by wolf and/or, dingo crosses," and goes on to quote that the greatgranddam of the famous Alsatian "Hector Von Wohlen" was the result of a cross between a dogwolf and an Alsatian bitch.

The book is not written merely for the technician; it will have an appeal for all dog-lovers, for Mr. Ash's researches have led him to study the dog from many aspects. There are chapters on dogs in relation to religion, medicine, law, and history in general. We learn that in Wales a certain cure for a cough is to put a hair of the patient's head between two slices of bread and give the sandwich to a dog, and also that the hair of a dog when burnt is a sure remedy when applied to a bite. The Chinese seem long ago to have come very near to Pasteur's great discovery. "If a man was hurt by a mad dog, then the man goes mad, the best cure was to use the brain from the same dog and put it on the wound."

As a work of reference the dog breeder will find Mr Ash's book invaluable, for in addition to the histories of all breeds, there are lengthy appendices in which show points, pedigrees of famous dogs. 5 and championship winners are given. The book the worthy of a bibliography and it is to be regre

at none is given, the only references being attered notes in the text and rather inadequate accountees

There are more than 150 excellent plates, in which are figured several hundred dogs, from those of ancient Assyria and Egypt down to the living championship winners of to-day. These have been collected from many sources, and they alone testify to the care and perseverance which have gone to the building of what will doubtless be a classical work on dogs and one which should find its way to every good reference library, as well as to the shelves of every dog-lover who can afford it.

### Local Floras.

- (1) The Flora of Buckinghamshire. with Biographical Notices of Those who have contributed to its Botany during the Last Three Centuries. By Dr George Claridge Druce Pp. exxvii + 437. (Arbroath: T. Buncle and Co., 1926.) n.p.
- (2) The Field-Club Flora of the Lothians. By the Botanical Committee of the Edinburgh Natural History Society Edited by Isa H. Martin. Pp viii + 142. (Edinburgh and London: William Blackwood and Sons, Ltd, 1927) 5s net.
- (1) TO be the author of three complete county floras is an achievement which we believe to be unique in the annals of British botany, although C. C Babington, in addition to his floras of Cambridgeshire and the Channel Islands, compiled the catalogue known as the "Flora Bathoniensis." The present flora is the third from the pen of Dr. Druce, whose flora of Oxfordshire was published in 1886 and the flora of Berkshire in 1897. A flora of Buckinghamshire is the m welcome as no previous flora has ever been putlished of the county, though a catalogue species without localities was issued by the Mr James Britten in 1867 under the title "Flora of Buckinghamshire." The work before a contains records of about 930 species, exclusive of aliens and the microspecies of Rubus and Taraxacum, or slightly more than the number recorded by Pryor for the neighbouring county of Hertford.

To the student of geographical distribution, the most interesting species of the area is Danaa cornubiense (Physospermum aquilegifolium), which is otherwise confined in Britain to Cornwall and Devon. The flourishing condition of this plant in its one station is, we may note, rendered significant by the fact that several 'western' species occupy their eastern limit at Burnham Beeches also. This is shown by the occurrence there of the liverwort

Microlejeunea ulicina, or the very rare snail Vitrina major, in company with the north-western molluse Acanthinula lamellata Of the extinct and diminishing species, it is of interest to note that plants of wet habitats predominate, as was shown to obtain in the neighbouring county of Hertford. The introduction contains a brief account of the contributions to the botanical knowledge of the county, in which a short autobiography of Dr. Druce is of especial interest.

This work emphasises once more the debt that British field botany owes to the pharmaceutical profession in general and to the author in particular.

(2) "The Field-Club Flora of the Lothians" is a much smaller work, of a size convenient for the pocket, and embodies the records of the Edinburgh Natural History Society. Localities are given, and a few ecological lists for some selected stations are furnished. Some eight species are noted as having recently become apparently extinct, any aget which we may note especially Corallorrhi innut. Lin næa borealis, Tecsdalia nudica s, t cambe mu' tima, Genista pilosa, "That is a tavum. and att. to be regretted the this little book w east i by the mi necessary inclusion a gloslary and we do plates illustrativ of the botanical term . ... bear no relaty on the main text and or see adequate to La comprehension of a disυra. Neverthelist. despite the diminished nience, field becauses will welcome this ada in to our local flora. E. J. S.

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pphances. By P. M. 170. (London: Crosby 1927.) 36s. net.

\* extremely varied, albeit highly of vessel, interesting alike to the t, the engineer, and the shipbuilder. on the subject of dredger design is, far from voluminous and, indeed, is able more for its paucity than for its fullness. '1: ce is abundant scope, then, for the volume by Mr. Dekker, and his description of a number of present-day dredging vessels and appliances forms a useful addition to the reference library of the practising engineer. It will be felt, on perusal, that the book is, in fact, mainly descriptive, and that it concentrates largely on individual examples of dredger construction. This does not detract from the utility of the work as a practical directory to the subject, but it still leaves the field open for a dissertation on the principles underlying dredger design. Such a work would, perhaps, be special province of the naval architect.

Mr. Dekker's book is not divided into chapters,

but is in two parts, with numerous sub-sections. Commencing with a historical résumé and account of early types, the modern bucket dredger is then subjected to analytical description, followed by similar treatment of the sand pump, the suction dredger, and the suction cutter dredger. There is no reference to the dipper dredger, the type so prominently in vogue in North America. No doubt this is due to the author's Dutch nationality and his intention, expressed in the preface, of giving solely an account of the development of dredging appliances in Holland. He points out that "as regards the more recent development, England and Holland may safely claim to have made the greatest progress." A number of interesting photographs and line drawings enhance the attraction of the book. BRYSSON CUNNINGHAM.

The Father in Primitive Psychology. By Prof. B. Malinowski. (Psyche Mimatures, General Series, No 8.) Pp. 93. (London: Kegan Paul and Co., Ltd., 1927.) 2s. 6d. net.

Savages, to use a popular term, are no more logical nd consist t than civilised peoples. This is a soint which is often overlooked and has been usefully emphasised by Prof. Malinowski on more than one occasion. Ever since it has been recorded that some primitive people norant of the part of the male in procreation, obvious difficulties which it is thought shou... ritably arise have caused some doubts as to the apleteness of this alleged ignorance. In this boo. Prof. Malinowski records the results of his inquiric, on the subject . ....ng the people of the Trobrianc Islands, with special reference to its bearing upon the position of the father as a purely sociological and not a biological factor in the family group. The results are extremely interesting, and if Prof. Malinowski has not been successful in disposing of all, he has at any rate solved some of the more serious difficulties. The case of the unmarried mother is still a stumblingblock, and the author has to fall back upon the explanation that a birth is contrary to the custom of society, a force which, when everything is taken into account, does not seem quite adequate, strong as it undoubtedly is. Prof. Malinowski has some illuminating remarks to make on the relation of this lack of physiological knowledge to the attitude of the natives towards Christianity.

Relativity: an Exposition without Mathematics. By Prof. James Rice. (Benn's Sixpenny Library, No. 105.) Pp. 79. (London: Ernest Benn, Ltd., 1927.) 6d.

In this paper-covered pamphlet of eighty pages, which is sold for sixpence, Prof. Rice sets forth the doctrine of relativity: and not only this, but also (as preliminaries to it) the principles of Newtonian physics, the history of optics in the nineteenth century, and the Maxwell-Lorentz theory of electricity. It is a wonderful performance—judicious, scholarly, well written, and sparkling with apt arisons and illustrations. A little master-piece in every way.

In the expectation that it will be continually

reprinted, and translated into every language und the sun, we venture to point out one or two thing which might be amended On page 13, after correctly describing FitzGerald as "an Irish physicist," the author refers to Larmor as "an English mathematician at Cambridge" Larmor is, however, another Irishman. On pages 51-52 we are told that the mass of the electron has been proved by experiment to be wholly electromagnetic: we do not understand what Prof. Rice means by this: at any rate, the Kaufmann-Bucherer experiments on the mass of  $\beta$ -particles merely show that their mass varies with velocity in the way that any mass, whatever be its origin, must do according to the relativity theory. On page 73, latitude is obviously a slip for *longitude*.

Elementary Practical Physical Chemistry. By Dr. James Frederick Spencer. (Bell's Natural Science Series.) Pp. viii + 263. (London G. Bell and Sons, Ltd., 1927.) 5s.

Dr. J. F. Spencer has written a very attractive book of practical exercises in physical chemistry. It is an elementary book, describing experiments which can be performed by boys and girls in the upper forms of schools. For this reason, complicated apparatus and tedious experiments have been avoided, and in certain cases new types of simple apparatus have been designed and put on the market, to enable additional experiments to be made. Since the requirements and possibilities of an elementary course in physical chemistry have now been to a large extent standardised, the detailed setting out of the work is more important than its scope, and for this reason Dr. Spencer may be congratulated on the clearness of the 89 diagrams which serve as illustrations to the 100 experiments, for which detailed instructions are given in the narrative of the text. The final test of such a book can only be applied under conditions of 'active service' in the laboratory, but from a preliminary inspection it appears likely that this test will be passed with credit, to the mutual advantage of all those who may be concerned in the enterprise.

Über die Warme-Leitungsfahigkeit der Metalle. Arbeiten von G. Wiedemann und R. Franz. Herausgegeben von Prof. Dr. Arthur Wehnelt. (Ostwald's Klassiker der exakten Wissenschaften, Nr. 222.) Pp. iii + 39. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1927) 2.80 gold marks.

The first requirement of any theory of the conduction of heat and electricity in metals is that it shall satisfy the law discovered by Wiedemann and Franz in 1853, that metals have the same conductivity for heat and for electricity. Although modern determinations have shown that the law is approximate only, it is most appropriate that the original paper should be republished and made widely available. The editor, Prof Wehnelt, has added a short life of Prof. Wiedemann and a few notes as to more recent work on the same subject.

#### Letters to the Editor.

[The Edutor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

# Discovery of the Function of the Pycnia of the Rust Fungi.

In a letter to Nature, published July 23, 1927, I do. d, on the basis of experimental evidence, that waking helianthi is heterothallic. The results of other experiments now enable me to state definitely nat Puccinia graminis is also heterothallic. Moreover, nee my first letter was written, proof has been obned that the pycnia (spermogonia) of the Rust gi are not, as many botanists have supposed conceptacles producing non-functional spermatia, reactive organs having a non-male function they carry out through the agency of flies. covery was made as follows.

y 1927, I had a large number of sunflower angs, upon the young foliage leaves of which there were many pustules of Puccinia helianthi. Each pustule had originated from a single sporndium and had numerous pyonia on its upper surface, and every pyonium had excreted a drop of nectar containing pyonospores. Theoretically, as set forth in my former letter, it seemed reasonable to suppose that the mycelium, pyonia, and pyonospores of some of the pustules were (+) in sex, whereas the mycelium, pyonia, and pyonospores of other pustules were (-) in sex.

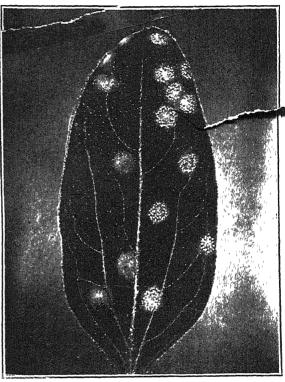
On May 17, Prof. A. H. Reginald Buller, of the University of Manitoba, was in the greenhouse of the Dominion Rust Research Laboratory inspecting the experiments in progress. A solitary fly, one of the first to appear after the winter season, had entered the greenhouse. Prof. Buller directed my attention to the fact that the fly was settling on the sunflower leaves, sipping nectar at the pycnia of one pustule and then flying off to another leaf and sipping the nectar of the pycnia of another pustule, and he at once said: "The solution of the problem of the function of the pycnium is an entomological one. Copy the action of the formulation and (-) pycnium special (-) pycnium and (-) pycnium special (-) pycnium and (-) pycnium

In two sets of experiments with Puccinia heliminion sunflower leaves, pustules of menosportial origin, each pustule having developed numerous pyenia but no æcia, were treated as follows: in 184 pustules the pyenospore-containing nectar was mixed with the help of a scalpel, the nectar of any one pustule being mixed with nectar of several other pustules; while, as a control, in 174 pustules the nectar of each pustule was stirred up with a scalpel, but not mixed with any other nectar, the scalpel being carefully sterilised before each operation.

Five days after the experiment had begun, the condition of the pustules was as follows: of the 184 mixed pustules 176 had produced æcia, 4 no æcia, and 4 had wilted and died through leaf-injury; of the 174 unmixed pustules only 20 had produced æcia,

while 154 were entirely free from æcia. Under normal conditions when the nectar is neither mixed nor stirred, a certain percentage of monosporidial pustules always produces æcia, as already recorded in my first letter. The appearance of æcia in 20 of the unmixed pustules was therefore in agreement with expectation.

From the experiments just recorded it is clear that mixing the pycnospore-containing nectar leads with rapidity and considerable certainty to the development of æcia. While the pycnospores are haploid, the æciospores are diploid. We can therefore also say that mixing the pycnial nectar causes each public of monosporidial origin to change from the haploid to the diploid phase.



The 1. - the ter our or saturdan - Thank x 11

Experiment, singuar to those pure described navo been under with Puccinia graminis on barberry reave. The one set of experiments the pychial nectar of 110 monosportual pustules was mixed; while, as a control, the pychial nector of each of 35 mosporidial pustules was stirred up separately but not mixed.

"Six days after the experient had begun, the condition of the pustules had broduced seen and 14 no sein; whereas of the 85 unmixed pustules only 17 had produced seein, while 68 were free from sein.

In the experiments with *Puccinia graminis* just described we again have clear evidence of the function of the pycnia; for, when the nectar is mixed, æcia are rapidly formed in most of the pustules, whereas when the nectar is not mixed, most of the pustules do not develop æcia. A certain percentage of mixed pustules always produces æcia, as in *Publianthi*.

In Fig. 1 is shown the under side of a sunfig. The leaf was inoculated with sporidia of

helianthi on July 9. Each pustule originated from a single sporidium and was therefore unisexual. On July 29 the pycnial nectar of the ten pustules on the right side of the leaf was well mixed, while, as a control, the pycnial nectar of each of the six pustules on the left side of the leaf was stirred separately but not mixed. On Aug. 3 the leaf had the appearance shown in Fig. 1, and on Aug. 4 the photograph was taken. This experiment again clearly demonstrates that the pycnia are functional, in that their pycnosporecontaining nectar, when transferred from one pustule to another, brings on the diploid phase as shown by the appearance of æcia within five days of the

In Fig. 2 is shown the under side of a barberry leaf. The leaf was moculated with sporidia of Puccinia

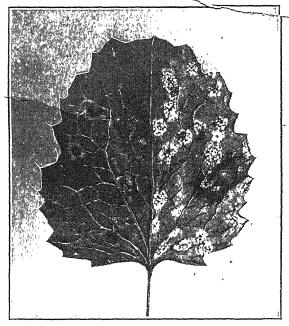


Fig. 2 —Under side of a barberry leaf. × 2.

graminis on Aug. 2. Each pustule originated from a single sporidium and was therefore unisexual. Up to Aug. 19 one pustule on the right side of the leaf had produced acia. On that day, the pycnial nectar of all the pustules on the right side of the leaf was well mixed; while, as a control, the pycnial nectar of each of the eight pustules on the left side of the leaf was stirred separately but not so red and 28 the leaf was about the appearance show the sto Nati The idicat of mixing the pycnial nectative as of Earlyt: It is appeared on the right side of that such mixing had been effected, but not on the left side where mixing had been avoided.

Proof that flies mix the pycnial nectar of separate

unisexual pustules and so cause the pustules to change from the haploid to the diploid phase, as shown by the appearance of æcia, was obtained with Puccinia

helianthi as follows:

Fifteen to twenty flies were enclosed in a large screen-wire cage with about twelve pots of sunflower seedlings, on the foliage leaves of which there were monosporidial pustules bearing pycnia but no As a control, flies were kept out of another reen-wire cage which contained fifteen pots of seedlings, on the foliage leaves of which 159 similar pustules.

Eight days after the beginning of the experiment 96 of the 98 pustules to which flies had had access had produced æcia and only 2 pustules no æcia, whereas only 5 of the 159 pustules to which flies had not had access had produced æcia.

It was found that in *Puccinia helianthi*, and also in *P. graminis*, nectar which had been heated to 70° C. to kill the pycnospores is not effective in including the production of æcia when mixed with the nectar of other pycnia on the living leaf. This indicates that it is the pycnospores which are the effective agents in inducing the formation of aecia, and not the necta

In a series of experiments with Puccinia heliant and in another series with P. graminis, the pycn nectar of one monosporidial pustule was removed in capillary tube and divided into several drops, and the the drops were applied singly to the pycnia of as mar pustules as there were drops. In response to t treatment some of the pustules produced acia others did not, thus indicating that the pycnos are of two kinds (+) and (-). The full det these experiments will in recorded elsewhere.

It appears that, under natura conditions, t three ways in which pustules of monosperid may change from the haploid to the diploid conui-(1) by a (+) sporidium and a (-) sporidium settling or a leaf close together, so that they form pustules which coalesce in such a way that the (+) mycelium and the (-) mycelium come into contact directly; (2) by means of flies which carry (+) pycnospores from one isolated pustule to the ( - ) pyonia of another isolated pustule or, conversely, ( - ) pyonospores of one isolated pustule to the (+) pycnia of another isolated pustule: and (3) spontaneously. The cause of the spontaneous change of a certain number of the pustules of Puccinia helianthi and of Puccinia graminis from the haploid to the diploid condition is at present unknown, but the phenomenon finds its parallel among the Hymenomycetes in Coprinus radians investigated by Vandendries and in C. Rostrupianus investigated by D. E. Newton.

The pyenia attract flies and reward them for their visits in very much the same way as do flowers or the Stinkhorn Fungus. They occur chiefly on the upper side of the leaves, where they are readily accessible to insects; they are usually yellow or red in colour, by which means—and perhaps also by the refraction and reflection of light in the drops of nectar-they are made conspicuous; in some species, e.g. Puccinia suaveolens, and possibly in many, they will an attractive odour, while, finally, they nectar contains sugar, and on this account avidity.

It has long been remarked In those rust fungi producing organs to appear. Since they play such an important part in changing the haplophase into the diplophase and in inducing the formation of meia, their appearance on the mycelium before the acia can now be readily understood. Pycnia procede acia, because by pycnial action acia are formed.

The crossing of two physiological forms of Puccinia

graminis, etc., might be effected in the following relatively simple manner: obtain monosporidial pustules of both strains and then mix the pyenial nectar of a (+) pustule of one strain with the nectar of a (-) pustule of the other strain, or, conversely, mux the nectar of a (-) pustule of one strain with the nectar of a (+) pustule of the other strain.

In my previous letter to NATURE I stated that, in Puccinia helianthi, the eciospores which had appeared in at least some of the acia of pustules of mono-sporidial origin are unnucleate. Further cytological experience has convinced me that the apparent

uninucleate condition of these æciospores was due to an artefact. The young ecrospores near the spore-bed of every æcium of monosporidial origin that I have investigated more recently have all proved to be

In conclusion, I desire to thank Prof. Buller for assisting me with valuable suggestions and helpful criticism

J. H. CRAIGIE.

The Dominion Rust Research Laboratory, Winnipeg, Oct. 13.

### The Cellulose Space Lattice of Plant Fibres.

Two different types of X-ray diffraction patterns and their interpretations, made from cellulose fibres, have appeared in the literature; one associated with a 'point diagram,' presented by R. O. Herzog, the other, with a 'line diffraction pattern,' by the writer 2

Although the two methods used were slightly different, both depend upon 'reflection' of monochromatic X from the uniformly spaced planes of atoms in the fibres, and should therefore be capable identical interpretation. The data in general are in fair agreement, except in two or three examples where the differences cannot be accounted for by experimental errors It is the purpose of this communication to direct attention to this lack of agreement, and to point out its effect upon the lattice structure proposed by Herzog.

In the Journal of Physical Chemistry, April 1926, pp. 455-467, Herzog discusses a lattice for cellulose which he considers a revision of his earlier work. In the data for this revised lattice there appears a series of interference points which are associated with planes parallel to the c axis of the elementary cell; that is, planes parallel to the long axis of the fibres. In that series particular attention is directed to points  $A_3$  and  $A_4$ . The data given below were taken from his Table I., and from them the interplanar spacings d were computed by means of the Bragg formula:

$$n\lambda = 2d \sin \theta$$
.

where  $\theta$  is the glancing angle, and  $\lambda = 1.54$  A. the K<sub>α</sub> wave-length for copper, since the radiation used was from a copper target.

Point.	$\operatorname{Sin} \theta$	d
$A_3$	0.17909	4·30 A.
$A_4$	0.1981	3 89

In the other type of diffraction pattern, as published m the Journal of General Physiology, Nov. 1925, pp. 221-233, and May 1926, pp. 677-695, I found no line corresponding to the 4.30 interplanar value for planes which were parallel to the long axis of the fibres. In making these patterns the X-ray beam was passed through a filter to ensure a monochromatic beam of Ka wave-lengths only. When, however, diffraction patterns were made later with the unfiltered radiation, a line which corresponded to the 4 30 value always appeared prominently. Since this interference maximum failed to appear when Ka wave-lengths only were used, and on the other hand always appeared clearly when the beam was a composite of all of its wave-lengths, it was suspected immediately that a single set of planes with strong reflecting powers had produced two interference lines, one from the  $K_{\alpha}$ , the other from the Ks wave-lengths.

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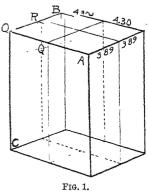
Calculation shows that the point A3 might have been produced by the Ks wave-lengths from the very strong 3.89 planes,

Point.	$\sin \theta$ .	$K_{\alpha}$ $\lambda = 1.54 A$ .	$K_{\beta}$ $\lambda = 139 A$ .
$A_3$	0 17909	4.30	3.89
Δ.	0.1981	3.89	

and since no line was found corresponding to the  ${\rm A_3}$  point when the Ks wave-lengths were filtered out of the beam, one must conclude that Herzog failed to recognise the Ks origin of the As point and gave it

the 4 30 value as though it were of Ka origin That value, therefore, should be discarded from the data.

Attention was directed to a similar use of-a Ks interference point (NATURE, Aug. 15, 1925, 243) in the original data of Herzog and Janeke which was published in Zeitsch. fur Physik, 3-3, 196-198, 1920, and m which incidentally this 430 value does not appear. That value apparently had been discarded at that time as of Ks origin.



When, however, one attempts to discard the 4.30 value now, a new importance is found placed upon it. The dimensions for the axes of the revised elementary cell as proposed by Herzog are given as  $a:b:c=8\ 60:7.78:10.22$ . This elementary cell may be represented by Fig. 1, where

$$OA = a = 8.60 = 2 \times 4.30$$
  
 $OB = b = 7.78 = 2 \times 3.89$ 

The two planes passing through Q and A respectively and parallel to the plane OBC are considered as being separated by the 4 30 distances, OQ and QA. Likewise OR and RB are the 3.89 distances. That the a axis is directly associated with the 4.30 value and the b axis with the 3.89 value is definitely fixed by the indices (200) and (020) respectively, given in his Table II.

It seems, then, that the values used for the a axis and the b axis of the elementary cell proposed were both produced by the same set of planes, and when the 4.30 value is discarded, as it seems evident that it must be, the axial dimensions proposed by Herzog lose their significance, and therefore a number of conclusions must be discarded. (1) That four se units are contained in the elementary anhydic 5. cell is now of co with casumptions that certain, terfer produced by impurities in the first state of the control of the contro (2) The -re are two types of carbohydrates en \_ cellulose of the fibre, are now also variout adequate basis. (3) The correspondence between the 4.30 value and a certain interference maximum obtained from mercerised cellulose likewise now has no significance. These conclusions at least must be discarded if the only basis for them lies in the elementary cell as suggested by Herzog. A lattice based upon the 'line diffraction patterns' seems to be in better agreement with the properties of the fibres, both physical and chemical. This structure is discussed in detail Sponsler and Dore in "Colloid Symposium," graph 4, pp. 174-202, 1926, and in the mentioned above. mentioned above.

University of California at Los Angeles

<sup>&</sup>lt;sup>1</sup> Herzog, R. O., "Nature of the Structure of Cellulose and its Significance in Chemical Transformations," Jour. Phys Chem., 30-4, 455-467; April 1926

<sup>2</sup> Sponsler, O. L., "Molecular Structure of Plant Fibres determined by X-ray," Jour Gen. Physiol., 9-2, 211-233; 1925: 11-5, 677-695, 1926.

#### The Lower Palæolithic Implements of Sligo.

When we published in Nature an account of the discovery of Lower Palæolithic Implements in Ireland, we expected that the announcement would give rise to a certain amount of disturbance among the more old-fashioned archeologists of that country, but we did not contemplate, or believe it possible, that this announcement would result in the appearance (NATURE, Nov. 5, pp. 652-3) of such a series of statements as that to which Prof. Macalister and his associates have been so unwise as to append their signatures. Incredible as it may appear, it is nevertheress a fact, as is clear from the particulars published in NATURE (NUV. 5), that these investigators have not even correctly located the site at Rosses Point, Sligo, where the collapsed rock shelter exists, the details of which, as given in NATURE (Aug. 20), are preserved m excellent photographic and other records, which are to be made public shortly in the memoir to be published by us, but have mistaken the promontory of The Rosses for Rosses Point, which constitutes the northern projection of the former. Prof. Macalister and his associates clearly indicate in their note in NATURE that they visited this spot unknowingly, and thus failed to observe the collapsed rock shelteror the Raised Beach of powdered shells. In view of this faulty observation it is not surprising to find that these investigators state that "there is no Raised Beach...in the district." This claim, however, is in direct opposition to the opinion expressed in the Geological Survey Memoir, "The Counties of Sligo and Leitrim," p. 27.

Prof. Macalister and his associates are clearly, therefore, engaged in the abortive task of attempting to criticise a site which has not been dealt with by When they were confronted with the fact of the discovery of paleolithic implements in (a) a rock-shelter, and (b) Boulder Clay in Sligo, the only course they could take in order to support the ancient order of archæology was quite obvious. All they imagined must be done was to deny that the rock-shelter is ancient, and that the specimens found in it, and in the Boulder Clay, are humanly flaked. It is true that these are matters open to discussion, but we have confidence that competent archæologists, not unscientifically determmed to deny the presence of palæolithic implements in Ireland, will give little heed to the arguments and assertions of Prof. Macalister and his In fact, all those with the requisite associates. knowledge enabling them to give a judgment of value upon the matter have, without one exception, at once accepted the Sligo specimens as of human origin.

As an example of the confusion of thought of our opponents, it may be pointed out that in neither of our note our note of the many be pointed out that in neither of our note of the statement of the relevance, or importance, of the statement that Mousterian artefacts are not as a rule of impressive size. Do our critics wish to suggest that this prevents the Sligo specimens from being regarded as of this age, and further, do they claim that the examples of very large implements from High Lodge, Suffolk, and other places, including Le Moustier itself, are also barred from a Mousterian status? As for the assertion that the change of colour coduced on the surfaces of stones by weathering is to be described as 'patination,' this is a dogmatic unsupported, as are most of the statements

in the note under discussion, by any

It is not for us to explain why the palaeolithic people of Sligo chose to flake limestone into implements, or to give reasons why the efforts of Prof. Macalister and his associates failed to produce a conchoidal fracture in this material. But the fact remains that the ancient people did both these things, not once but many times, as may be seen by an examination of the material collected in Sligo, and exhibited at the rooms of the Society of Antiquaries of London until Dec. 6.

We, of course, regret that our critics failed to find any artefacts when visiting the Sligo coast, but this is possible of explanation on two grounds: either that the previous searching was so thorough as to leave nothing to be found, or-as is more probable because Prof. Macalister and his associates did not know what to look for and preserve. It is not necessary for any demonstration to be given of the manner in which the Sligo specimens were flaked, as a swardy of these by anyone familiar with the flaking of stone will show clearly, and beyond any question, that the method utcombed in Nature (Sept. 24) was indeed carried out in ancient times. Further, it is to be doubted—even if such a demonstration were given—whether Prof. Macalister and his accounter would understand it. They are evidently unfamilia. with the Mousterian technique by means of which Levallois flake-implements were detached from prepared cores. The Sligo method-with two minor differences—is absolutely true to type, yet our critics describe it as 'complex.' This it may appear to them, but it is otherwise with archeologists who have made a study of these matters.

Prof. Macalister and his associates, with a thoroughgoing disregard of ordinary scientific procedure which would have necessitated an examination of the Sligo specimens before passing judgment upon them, nevertheless do not shrink from inforring, in the columns of NATURE, that they are of natural origin. On the other hand, their supporter, Mr. Warren, regards the same specimens, with the exception of those found in Boulder Clay at Ballyconnell, as made by man This, to say the 'east, is unfortunate, especially in view of the inherently had case which our critics have to defend. Lastly, we may direct attention to Mr. Warren's statement that, apropos of the Sligo material, there is "no passable resemblance m any one of these flakings to any form of prehistoric implement, either palæolithic or neolithic." strange claim is indeed a classic example of the truth of the saying that given sufficient rope, certain people are bound to hang themselves Anyone interested in this matter who has visited the exhibition of th Sligo specimens at Burlington House will, we have no doubt, agree with us that Mr. Warren, togethe with Prof. Macalister and his associates, have suspended themselves in a very thorough and fatal manner.

J. Reid Moir.

One House, Tpswich, Nov. 8.

J. P. T. Buremerl.

#### Manoilow's Blood-test for Sex.

In Nature of Nov. 5, Mr. Perkins makes a valuable contribution to the study of chemical manifestations associated with sex, but he gives an erroneous impression of Dr. Manoilow's work on sex-identification by blood-tests in two respects. (As I am in possession of a recent review of this work by Manoilow hunself, which it is hoped to publish soon, I am able to correct these wrong impressions.) In the first place, the workers mentioned by Perkins are mostly disciples, who have merely either applied

Manoilow's technique to some additional organisms, or have attempted to reduce the complicated reaction evolved by Manoilow to a simpler one. In the second place, Manollow worked for some years on the serum of "cows and oxen, horses, cocks and hens," as well as man, before he published (Wratchebnaia Gazeta (Medical Journal), 15, 21-22; 1923) the earlier accounts of his work on the identification of sex in man and other animals by a biological reaction of the blood.

In discussing the results of applying his test, Manoilow shows that although in some categories of individuals—as those furnishing samples of blood from venereal clinics—he was able to determine sex accurately in 100 per cent. of cases, in others the percentage of accurate determinations was less than 100, but in the latter instances the degree of accuracy is high, and mostly significant. It is clear, therefore, that Manoilow has discovered a series of phenomena of fundamental importance in the study of sex, whether his test be infallible or not. The word liscovery is used advisedly, because the problem was attacked deliberately. Whether this reaction be was attacked deliberately. Whether this reaction be found—ve: ually to define particular sex-attributes or sex-products, or only a particular metabolic condition closely associated with sex, we are indebted to Manoilów for epening up this avenue of research, the vista of which beckons with the promise of great results in the future.

Now the reaction as evolved by Manoilow is not only delicate, as Perkins points out, but also intricate, and it is doubtful whether any worker would attain to the original researcher's standard of success in its use, without both meticulous attention to the detail of the test, and considerable experience in applying it. It is the object of the account mentioned above to present to English workers full details of the test.

At about the time Manoilow succeeded with his test for sex, it was suggested independently in Nature 'vol. 111, p. 879; 1923) that a chemical test for sex 1. ight be found to be possible in invertebrates, because of the common occurrence of a difference in colour of the pigments in the gonad of males and females of the same species. Thus the underlying idea of this suggestion was not that a universal test might be found for sex, but rather that specific chemical tests might be devised for differentiating sex in given species. It would seem that the basis of this latter idea might be usefully incorporated in the evolution of the Manollow and similar tests. It is possible that a slight variation in the technique of the reaction in each species might give constant differential results correlated with the two pure positive sex-conditions, for the primary object of the test is the infallible determination of pure males and pure females.

J. H. ORTON.

Marine Biological Laboratory, Plymouth.

#### Parental Care in the Cichlid Fishes of the Victoria Nyanza.

According to various natives from different places on the shore of the Victoria Nyanza, many of the lake fishes (all except the silurids, according to one fisherman) carry their fry in their mouths. One variation of the story makes the eggs pass internally from the ovary to the pharynx: in another the eggs or fry are gathered up from the nest in case of danger.

The account was received with almost the same caution accorded to the story of the monstrous serpent of the lake, but it has been found to apply

to several cichlids.

Eggs have been found in the mouths of Haplochromis macrodon (at Kisumu from a small native papyrus seine on Aug. 17) and H. nubilus (at Bukoba from a cast-net on Sept. 7). Newly hatched young were found in the mouth of one specimen of H. nubilus taken in a cast-net at Bukoba on Sept. 6. Two specimens each with young advanced beyond the stage of complete absorption of the yolk-sac were taken in the same manner on Sept. 6 and 7. One Tilapia variabilis taken from a large native papyrus seine at the mouth of the Kibos River near Kisumu on Aug. 14 had young in its mouth with the yolk-sac almost completely absorbed. Advanced young were taken from H. crassilabris at Kısumu on Aug. 17.

One haul with a seine on Rusinga Island at the mouth of the Kavırondo Gulf on Sept. 1 yielded 19 cichlids. Seven of these had eggs or young in their mouths. These were placed in an aquarium, and included various stages from eggs which hatched within an hour to young in which the yolk-sac was completely absorbed. The seven fish were: one Macropleurodus bicolor, five Haplochromis nubilus, and one H. ishmaeli.

On Aug. 24 one H. ishmaeli was kept alive of two taken with young in the mouth. This fish and its fry were placed in an aquarium, and towards evening it was observed that the fry had gathered up into a fairly dense shoal near the parent's mouth and their apparent number had decreased. Parent and fry died shortly afterwards.

In all cases the parent concerned was the female. The Tilapia parent and young were kept in a vessel for one week. Although the fish was not supplied with food, the young were not eaten, which is not in keeping with a theory that the fish taken with small fish in the mouth were caught in the act of eating

In several cases the mouth of the mother was packed quite full of eggs or young, so that the soft part of the lower jaw was noticeably distended.

The nomenclature used herein is after Tate Regan (Proc. Zoo. Soc., 1922). MICHAEL GRAHAM.

Fishing Survey of Lake Victoria, Kisumu, Kenya Colony, Sept. 16.

#### Application of the Interference Method to the Determination of the Surface Area of Metallic Nickel Films.

WITH the quantitative establishment of the interference theory of the production of colours on metallic copper (Proc. Roy. Soc., A, vol. 115, p. 570; 1927) and its application to the study of the sintering of reduced copper films by heat treatment (Jour. Chem. Soc., July, p. 1597; 1927) the behaviour of nickel films becomes of increasing interest. Spectrophotometric observations on the growth of oxide films on nickel showed again that interference was the primary cause of the colours developed during oxidation, and hence the same method is applicable to the study of nickel films. Moreover, the dispersion shown by nickelous oxide is very much smaller than that shown by copper oxide.

Taking advantage of the indifference of metallic mckel to carbon at low temperatures (N<sub>12</sub>C seems to be formed at 2100° C., but rapidly dissociates at lower temperatures) the nickel was electrolytically deposited on china clay coated with graphite. The nickel film was activated by oxidation in air and reduction by hydrogen at 520° C., and the conductivity of the film was plotted against the equivalent air thickness corresponding to the colour shown by the partially oxidised rod. From the slope of the straight line so obtained the surface area per unit mass may be calculated.

Let M be the mass of the nickel being oxidised, and S be its surface area,

c be the initial conductivity of the metal,

t be the thickness of the oxide film when the initial conductivity has fallen by  $\Delta c$ , and

μ be the refractive index of the oxide for middle of the absorption or reflection band in the spectrum of the film.

Then

$$\frac{S}{M}\!=\!\frac{74\cdot7}{6\ 4\times58\cdot7}\cdot\frac{\mu\cdot\Delta c}{c\cdot t}$$

For the electrolytic metal the preliminary results gave  $3.94\times10^3$  sq. cm. per gram, on activation by alternate oxidation and reduction at  $520^\circ$  C., the value fell to  $3.10\times10^3$ ; this catalyst was oxidised and reduced at  $400^\circ$  C. On re-oxidation at  $400^\circ$  C. the active portion of the surface, which oxidised very easily, had the increased area of  $1.4\times10^4$  sq. cm. per gram. The area of the supporting material was  $2.14\times10^3$  sq. cm per gram of nickel, showing that the surface of electrolytic nickel is 1.84 times the apparent area, and that the apparent surface may be increased considerably by reduction at  $400^\circ$  C.

F. HURN CONSTABLE.

St. John's College, Cambridge.

# Thermal Degeneration of the X-ray Haloes in Liquids.

The theory of X-ray diffraction in fluids put forward some years ago by the writer with Dr. Ramanathan (Proc. Ind. Assoc. Cult. of Science, vol. 8, pp. 127-162; 1923) indicates that the diffraction halo exhibited by liquids under ordinary conditions should be strikingly modified by rise of temperature. As explained in that paper, it follows from thermodynamic considerations that at ordinary temperatures the molecules of a liquid are ordered in space with a high degree of regularity, and the comparative sharpness of the X-ray halo at such temperatures is a consequence of this fact. With rise of temperature, however, the molecules are thrown into increasing disarray, as is shown by the considerably enhanced scattering power of the liquid for ordinary light. Accordingly, we should expect the X-ray halo to become more diffuse and faint; it should also contract to some extent, owing to the diminished density and consequent increase of the mean distance between neighbouring molecules. Vice versa, if the liquid is supercooled until it congeals into a glassy solid, we should expect the halo to become sharper and brighter, and at the same time to dilate somewhat.

These consequences of the theory as well as the influence of the asymmetrical shape of the molecules on the structure of the X-ray haloes, were set out clearly in the paper, though at the time it was written no experimental evidence could be adduced in support. It is satisfactory to note that an examination of the subject undertaken by Dr. N. K. Sethi and Mr. S. S. Ramasubramanian in the writer's laboratory has shown the predicted degeneration of the diffraction halo with the rise of temperature to be an experimental fact. There is found, as expected, a progressive change of the halo from a comparatively sharp and bright ring in the amorphous solid at low temperatures to a fainter and more diffuse aureole in the liquid state at high temperatures. C. V. RAMAN.

210 Bow Bazar Street, Calcutta, Oct. 16.

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#### Solution of the Equation $\sin \theta/\theta = c$ .

A MUCH simpler solution of the above equation than that given by Mr. V. Naylor in Nature of Oct. I may be derived by expanding the expression on the left into a series of ascending powers of  $\theta$ , and transforring the higher terms by successive approximations to the other side as terms in powers of d, where d = 1 - c. The solution so obtained is.

$$\theta = \sqrt{6(d+0) 3d^2 + 0 137d^2 + \dots}$$

This expression is so convergent that the second term does not affect the value of  $\theta$  by half a second for values of  $\theta$  up to 2°·6, the third up to 15°, and higher terms only affect the result for angles more than 30°. For small angles, or for a fair approximation with larger angles, we may simply write the solution  $\theta = \sqrt{6d}$ , or for  $\theta$  in degrees, 140° 345  $\sqrt{d}$ . It c be very near unity, the complement has fewer significant figures than the reciprocal, while the terms in  $d^2$  and  $d^3$ , when required, are so small that they can be worked by slide rule or three- or four- figure logarithms for adding to d. E. Levin.

1 Denbridge Road, Bickley, Kent, Oct. 8.

#### Viscosity of Metals: Bismuth.

SINCE publishing the concluding part of my investigations on the viscosities of metals ( $Phil.\ Mag.$ , April 1927, Supp.) I have come across the following data for bismuth—a metal I could not procure in the form of a wire. In an attempt to study, for a different purpose, the elastic properties of pure bismuth wires prepared from electrolytically deposited metal, J. E. Harris ( $Phys.\ Rev.$ , First Series, 35, pp. 95-119) tabulated the values of log. dee for different amplitudes for a wire of length 106 cm.; diam., 0.25 mm.; period, 10-498 sec.; moment of inertia of the solid, 133 gm. cm.²; which on extrapolating for zero amplitude give  $\lambda_0 = 0.00978$ . These results give for the coefficient of viscosity of bismuth, at 23°.7 C.,  $13.71 \times 10^8$  poises—a value quite in a line with others obtained by me with thirteen metals and seven alloys.

As these experiments were not conducted in an airfree chamber the above result for bismuth is, however, likely to be slightly higher.

G. Subrahmaniam.

Vizianagaram, S. India, Sept. 1.

# The Temperature Variation of the Elasticity of Rochelle Salt.

Mr. R. Morgan Davies's letter on this subject in Nature of Sept. 3, recalls at once the analogy between piezo-electric phenomena and the reciprocal relations between strain and magnetic properties shown by ferromagnetic metals.

In particular, there is a stationary value in the Young's modulus—temperature curve for nickel at about 400° C., the Curie point for that material (*Proc. Phys. Soc.*, London, vol. 27, Dec. 15, 1914).

(Proc. Phys. Soc., London, vol. 27, Dec. 15, 1914).

A close examination of the temperature variation of the thermal expansion of a piezo-electric crystal would be expected to reveal a discontinuity at the temperature of abrupt change in the piezo-electric modulus which, if present, would be analogous to that found by the writer in the thermal expansion of nickel (Phil. Mag., June 1904), and confirmed by Colby (Phys. Rev., 30, pp. 506-521; April 1910).

E. P. Harrison.

H.M.S. Vernon, Portsmouth, Oct. 19.

# The Empire Mining and Metallurgical Congress in Canada.1

AT the Second (Triennial) Empire Mining and Metallurgical Congress, opened on Aug. 20, at Montreal, then continued across Canada to the Pacific, and eventually ended at Quebec on Sept 26, the underlying motif was the question of mineral resources.

At the opening session a resolution that the question of a review of the mineral resources and industries of each administrative unit throughout the Empire be transmitted for consideration and report, respectively, to the individual societies represented on the Empire Council, was adopted unanimously, after discussion and support by representatives from Australia, South Africa, India, the Crown Colonies, and the home country; while at the final meeting of that Council at Quebec a recommendation was adopted that for the coordination of such reports the Council should appeal for financial support and then set up an executive commensurate with the support forthcoming.

Canada, which through its governments and its mining industries had so largely borne the expense of organising this Congress, contributed to the question an exposition and display of her own wonderful mineral resources. Abundant brochures and booklets had been prepared and were distributed by the Department of Mines, the development department of the Canadian Pacific Railway, and the Canadian banks In these the position was presented that the present mineral resources of Canada were responsible for that country standing third among the nations of the world, and second within the Empire, as a producer of gold; for Canada supplying something like ninety per cent. of the world's nickel, seventy-five per cent. of the asbestos; and something like ten per cent respectively of the world's lead and zinc; and if the British Empire produced but a small percentage of the world's copper, Canada at least was the greatest producer and possessed the greatest copper mine within the All this with but half a per cent. of the world's population!

Present production is, of course, not necessarily a safe guide to mineral resources, these depending upon the unworked reserves. But the rapid rate of increase in Canada's mineral production, instanced by an increase from a value of sixteen million sterling in 1906 to fifty million sterling in 1926, is sufficient evidence that the extent to which the resources have hitherto been depleted by production has been more than made good, as we know it has, by both flattering developments of the known deposits and by new discoveries. Canada, indeed, has this century been the country of new discoveries: the silver field at Cobalt, Ontario, was discovered in 1902; the goldfield at Porcupine, Ontario, now containing the second largest gold mine in the world, in 1906; the relatively richer Kirkland Lake goldfield, Ontario, in 1912; while the promising gold-copper deposits at Rouyn, Quebec, were discovered in the present decade. It

 $^{1}$  The constitution and  $\it raison~d'\it etre$  of this Congress were outlined in Naturn of Aug 13.

is therefore safe to say that Canada's mineral production and reserves will continue to increase, and that where exhaustion may loom in some older mineral countries, buoyancy reigns in this country of all variety of geological formation and all vastness of unexplored extent.

All the foregoing districts were visited, and in addition such older established fields as the Sudbury copper-nickel field, Ontario; the asbestos areas at Thetford and Black Lake, Quebec; the Sullivan lead-zinc mine, the Britannia copper mill and the Mountain-Copper mine, British Columbia; the Saskatchewan lignites; and the Alberta coalfields. For lack of time the important Portland Canal district in north-west British Columbia, and other less important districts, could not be visited. Everywhere opportunity was provided to observe geolological occurrence, mining method, mechanical treatment, and metallurgical treatment; and in the end the visitors had a good general idea of the importance and outlook of each district.

Structural geology and regional petrography being all-important in the consideration of mineral deposits, no proper appreciation of the mineral resources of Canada is possible without some knowledge of the great natural petrographic provinces into which the Dominion may be divided. There is first the great pre-Cambrian area of hard ice-levelled outcrops which, sweeping widely around Hudson Bay, embraces entire Quebec; Ontario in far greatest part, crossing into the United States; the northern three-quarters of Manitoba and the northern half of Saskatchewan; the north-eastern corner of Alberta; a large portion of the North-West Territories, and altogether more than onehalf the superficies of Canada. In this ancient country-rock, otherwise sterile and forbidding, and within the relatively small area explored, occur among others the productive Sudbury, Cobalt, Porcupine, Rouyn, and Flin-Flon deposits, that is to say, deposits respectively of copper-nickel, silver, gold, gold-copper, and copper-zinc. In this area also, in addition to the smelters in the Sudbury district, are the Port Colborne refinery on Lake Ontario, the smelter and refinery at Deloro, and the Hamilton Works of the Steel Company of Canada.

Next in mineral importance comes the Pacific Highland of British Columbia embracing the Rockies and the Coast Ranges, where tilted and folded sedimentaries ranging from pre-Cambrian to Tertiary, alternate with intrusives and volcanics. In this scenic realm occur among others the Premier gold-silver mine and the Hidden Creek copper mine to the north-west, the Britannia copper mine on the Howe Sound to the south, and the Sullivan leadzinc mine in the Boundary District. Here also are the famous Trail smelter and refinery and the Anyox smelter. Between these two great metalliferous provinces come the Great Plains which, embracing the remainder of Manitoba, Saskatchewan, and Alberta, certain coal and lignite, oil and bituminous sand, building stone and other non-metalliferous minerals, representing a mineral wealth and reserve second only to the riches of their fertile soil. Finally, to the east come two smaller divisions, the Atlantic Provinces and the St. Lawrence Lowlands, where occur asbestos, coal, oil, shales, gypsum, and other non-metalliferous minerals.

Physiographically, half of great Canada is rocky, one quarter is covered by thick and valuable forests, somewhat less than a quarter by rich fertile soil, while the remainder is occupied by lakes or buried under moss. The agricultural and lumber industries take precedence of the mineral industry, both in their greater value and in their longer establishment. The mineral industry, started later, now challenges this precedence and, making valuable the rocky and inhospitable places of the Dominion, has earned the sympathetic consideration of the Government.

In the matter of prospecting this consideration almost becomes co-operation. The mineral discoveries in the past have largely been fortuitous and in Ontario largely in process of railway construction. But to-day geology helps. Dominion and Provincial geologists are early in the field anxious and ready to point the way to areas where rocks and structural conditions are favourable to discovery in new fields or to recurrence in known fields. Indicative of the importance which the Government attaches to the geological study of mineral deposits, Dominion geologists accompanied the Congress throughout, while Provincial geologists were detailed to be of service in their particular areas. Instrumental or geophysical prospecting plays little part, dependence being placed upon the close observation of surface indications and the intensive examination of available exposures.

All types of ore deposit are represented, some here, others there, magnetic segregations, replacements, fissure fillings, disseminations, steep lodes, flat beds, stepped lenses, irregular masses. There are also all variations in relation to dependence on proximity to the surface, from pronounced secondary enrichment as in the upper levels of the Premier gold-silver mine in British Columbia, to absence of all signs of secondary enrichment as in the pre-Cambrian area, where any such effect of weathering has long since been removed by glaciation. Surface discoveries in this latter area have accordingly this greater importance that they represent primary ore which is as likely to increase in value with departure from the point of discovery as to decrease, and in general character is not likely to vary. They have also this further importance that being in rock which, though now at the surface, was nevertheless under pressure of depth at the time of their formation, further development in depth is as likely to disclose an increase in size as a decrease, no further consolidation having to be expected. In this area it has been the repeated experience that the surface or shallow indications did not do justice to the value and size afterwards disclosed; indeed some valuable ore bodies developed underground were not even represented at the surface.

In the testing and development of discoveries, not only do shaft sinking and tunnel driving proceed apace, but diamond drilling even more so.

So flattering have recent developments been on particular discoveries that early results are everywhere now regarded as an urgent necessity, as witness the fact that recently a diamond drill was despatched to a prospect in Central Manitoba by aeroplane. Nor does such drilling necessarily slacken when a sufficient mining equipment is functioning and underground levels and roads are rapidly opening out; at appointed intervals to right and left and underneath the drill keeps in advance, defining the limits of the known ore-bodies and probing for others. In this way mineral reserves become indicated before being actually developed and a proper scale of operations is projected at an earlier date.

With regard to mining methods, Canadian mining is not yet very deep, the deepest shaft being one just over 4000 feet in the Porcupine district; nor by reason of many workings close together have special methods had to be devised to meet the pressure of heavy ground; standard methods are in use everywhere Shaft mines are represented by general practice in the pre-Cambrian area where the deposits stand steeply and where sufficient mass can rarely be recovered from open pits; they are represented also in the shallow coal and lignite fields of the Great Plains. Tunnel mines worked from the hillside are the feature of the Pacific Highlands. Among these, deserving of especial mention is the Sullivan lead-zinc mine in the Boundary district which works a flatly inclined massive sulphide bed, in places of immense size. Here the present mining method is to support the roof, leaving regular mineral pillars, the intervening excavations being as large as the strength and solidity of the roof allows. Actually some of the resultant excavations are so large that their limits could only be made visible by searchlights, and climbing within them from one level to another gave at times the impression of mountain climbing at night. In these Highlands and adjacent country the coal seams, being contorted and folded, are worked from the hillside. Openpit mining is represented by the asbestos mines in Quebec, where the pits, and equally the resultant dumps, are of staggering proportions; by the Copper Mountain mine in south-east British Columbia; and by the mining of some thick and shallow coal beds in

In the beneficiation of the material mined, that is, in the milling processes preparatory to metallurgical treatment and in the metallurgical processes themselves, Canada has much to show.

Alberta.

In milling practice most impressive and convincing was the separation by differential flotation of lead and zinc sulphides from one another, and both from the worthless portion of the complex fine-grained ore at the Sullivan mine With the first successful introduction of the flotation process in 1910, this property, which had been lying in abeyance for lack of any suitable treatment, became once again of interest, now, with the further development of that process to differentiate between sulphide and sulphide, it has become one of the most profitable lead-zine mines in the world.

The mill there is a triumph of applied science Arriving at the mill head, the ore is mechanically crushed, conveyed, weighed, sampled, and ground to pulp with water. This pulp is then churned and infused with air, while reagents are added. These reagents, though added in such infinitesimal quantity as only to contaminate, are of such potency that when the first is added the lead sulphide floats in the resultant froth, and the zinc sulphide afterwards with the second, the stony Broken down material sinking to be discarded with water these froths separately are settled and filtered, the relatively dry sulphides dropping on to conveyors to be carried to railroad wagons waiting at the tail end, sampling taking place on the way. Hundreds of tons a day of each sulphide and a thousand tons together are thus recovered, with no man handling the material.

Scarcely less fascinating but not so modern is the recovery of asbestos fibre from its serpentine matrix. First comes again the effective release of the valuable material by appropriate comminution, the last stage being here by an impact blow in air. The effect of this communution is that while the serpentine is reduced to granular powder the asbestos fibre is teased into light fluffy masses. Passing this mixture under stationary vacuum cleaners the fluffy asbestos is sucked up and away while the worthless granular material passes on, eventually to reach the dump waste.

Pure metallurgical practice in Canada is even more impressive. Pyrometallurgy is represented by roasting, matte-smelting, and converting, in the well-established production of nickel metal and matte and blister copper at Sudbury, Ontario; in the grand-scale beneficiation of lead and copper at Trail, British Columbia; and in the hopeful erection stage for the production of gold-copper matte at Rouyn, Quebec. Fire also effects the final melting and casting of fascinating yellow gold at Porcupine; of shining white silver at Cobalt; of resplendent red copper, of dull white lead, and of crystalline white zinc at Trail; and of hard white nickel at Sudbury.

It is nevertheless in electro-metallurgy that Canada secures pride of place, taking advantage of abundant current generated by cheap water power. At the Trail smelter, fire for roasting, solvents for dissolving, current for deposition, and fire again for melting, is the sequence by which 280 tons of refined zinc bars are produced each day, the only other comparable electrolytic zinc plants in the world being at Great Falls, Montana, and at Risdon, Tasmania, these being smaller. Here also 400 tons of electrolytically refined lead and 60 tons of refined copper are produced daily, together with about 20,000 ounces of silver and 100 ounces of gold gathered from the electrolytic cells. The long extended halls in which the thousands of depositing boxes necessary for these tonnages are accommodated are impressive in their immense size and in their attendant equipment, travelling cranes sweeping overhead to bring in the heavy anodes and to withdraw the loaded cathodes, and ground trams for the transport of lighter units.

At Trail, in the production of the refined tonnages mentioned above, all modern metallurgical operations and all modern metallurgical appliances are represented, and the whole complex becomes the largest non-ferrous metallurgical works in the world, electrolytic refining being its special feature.

Hydro-metallurgy is represented at Porcupine and at Kırkland Lake, more purely perhaps in the latter district. There is nothing new in the procedure. But the ordered design and simple lay-out manifest the assurance which came from knowledge of the problem Dull, unmetersing-looking ore enters at one corner of the building while fascinating gold bars leave at a far corner, with no apparent connexion between the two. But there it was, the trained man's capacity and intelligence!

The heart of one and all of these vigorous mineral enterprises is at the office and laboratory. The knowledge of which use is made comes from all over the world. Mineral resources are not to be measured only in terms of the earth's physical endowment, but also in terms of the vigor and intelligence with which they are sought and turned to account. In this matter Canada is worthy of her sons, while they in turn are blessed in her mineral fertility.

The Empire as a unit produces something like a quarter of the world's mineral output, lacking in but few mineral or metal commodities. The mother country of itself contributes practically nothing to the output of the non-ferrous major base metals, or to that of the precious metals. Yet in her sons, by research, experiment, and invention, she has contributed worthily, to wit: the Bessemer process which, originally revolutionising steel making, is now an important factor in the beneficiation of copper, nickel, and associated precious metals; the Macarthur-Forrest cyanide process for the recovery of gold and silver, which revolutionised precious metal mining, and, finally, the impulse through Elmore, Sulman, Picard, and others, to the present perfection of the flotation process by which the base metal mining industry has been equally revolutionised and mankind benefited.

A further contribution of the mother country to the mineral industry has been that of capital. In South Africa, Australia, India, and in Canada, British capital from the mother country has been of use, in large measure profitably to those supplying it. It is Canada's hope that one result of this Congress may be that more of such British capital may be forthcoming for the development of her resources, to the particular advantage of those venturing it and to the advantage of the Empire as a whole. Capital is particularly wanted for the initial stages, the testing and development of discoveries. British capitalists considering to take an interest in Canadian mining must accept the position that Canadians believe in, and by recent experience are justified in believing in, the great mineral possibilities of their country, and that they apply this belief to each individual mine and discovery; boldness with discrimination is therefore required. On the other hand, such capitalists may assure themselves that the Canadian public is itself willing and anxious to share in mining risks. The government is good and stable, and sympathetic to pioneer effort, readily making roads and railroads. The country abounds in cheap power, in water, and in timber, and labour is plentiful and efficient.

The Canadian mineral industry will continue to develop Capital will be attracted, and the desire of Canadians that more of that capital shall be British is both real and honest, springing from the fact that, sharing them, they admire British ideals and British institutions, and highly value the British connexion. Though much has been done in opening out Canada, Canadians realise that much more remains to be done and some things to improve, and they would have this further development conducted so far as possible in harmony with British ideals.

On their side the British visitors, from wherever they came, were moved by the warmth of their reception everywhere, and stirred to admiration by the monuments of Canadian construction and

enterprise. In the fellow-feeling and confidence therefrom engendered lies the gain to Canada. The gain to the visitors lies in having seen what has been accomplished in Canada

Lest it should appear that the Imperial note has been stressed unduly, the following concluding paragraph of the report on the Congress by the representative of the Engineering and Mining Journal of New York may be quoted. "I was not part of the Congress-merely an onlooker, a correspondent, reporting what I saw and heard. I am not even British, and this has been a British party. Nevertheless I was accorded every privilege and every consideration, wherever we went. Collectively, and individually, I have never seen a more interesting, sociable, and friendly group of people. Possibly one reason for this is the fact that mining is distinetly a world-wide industry and that mining people have much in common no matter whence they come; but behind that is probably the simple fact that they are British." S. J. TRUSCOTT.

# Directional Wireless as an Aid to Navigation.

By Dr. R. L. SMITH-ROSE.

FTER several years of struggle with a rather conservative race of navigators, the wireless engineer and scientist are becoming successful in the application of directive wireless transmission or reception to both aerial and marine navigation; and it can now be said with some confidence that in a very few years time the wireless directionfinder, or some alternative means of navigation by wireless, will be considered as essential as a compass on board every ship of any importance. Already a considerable number of ships of all nationalities, with those of Great Britain leading the way, are fitted with a direction-finder, an instrument which enables a ship to take bearings on wireless transmitting stations and to fix its position with some accuracy at times when all other navigational methods fail.

The application of wireless transmission as an aid to navigation is conveniently divisible into two parts according as the directive characteristic is applied at the transmitting or the receiving end of the wireless link. Although both forms are probably of about the same age, the directive receiver has developed the more rapidly and will thus be considered first.

# THE DIRECTIONAL RECEIVER OR DIRECTION-FINDER.

Stated briefly, the fundamental principle of the wireless direction-finder is the rotation about a vertical axis of a plane vertical loop or its equivalent in space. The electro-motive force induced in such a loop by an arriving stream of electro-magnetic waves is proportional to the cosine of the angle between the plane of the loop and the direction of the waves. Thus as the loop is rotated about its vertical axis the strength of the received signal varies from a maximum to a minimum or zero, in accordance with the well-known figure-of-

eight polar diagram. A consideration of this diagram shows that the rate of change of signal strength with rotation is greatest at the minimum position, which is therefore always used for direction-finding.

(a) Accuracy of the Direction-finder.—There are several manufactured forms of direction-finder employing the above principle, and their accuracy when used under the best conditions may be said to be about 1°. Under most practical conditions, however, the instrument is subject to certain errors in determining the direction of a distant transmitter. In part these errors may be due to an actual deviation of the waves from their rectilinear path in crossing a coastal boundary, for example, when a maximum deviation of about 5° may be produced for wave-lengths of the order commonly used in marine direction-finding. On the other hand, the errors may arise from the presence of local conditions near the directionfinder, such as trees, metalwork, and overhead wires, the currents induced in which result in secondary fields being superimposed on the primary wave field and so produce a minimum signal in a false position of the direction-finder. As a result of several years' investigation these errors are now well understood, and in most circumstances they may be avoided or compensated for after reduction to a minimum.

(b) Position of the Direction-finder.—In the application of direction-finding to marine navigation, a point of some debate has been the most desirable location for the instrument, on shore or on board ship. When erected in suitable surroundings, the shore direction-finder has an accuracy superior to that of the ship installation, for in the latter case the wireless bearing is taken relative to the ship, and reference must be made to the compass in order to determine the orientation of the

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ship at the instant the bearing was taken Moreover, the ship direction-finder is subject to a local error of a quadrantal nature due to the currents induced by the arriving waves in the metalwork, hull, stays, etc., comprising the ship itself. On the other hand, it is natural to find that the average ship's navigator does not care to entrust himself to the observations of an individual on shore with whom he is not in personal touch, and particularly at critical times in stormy or foggy weather, he much prefers to have the instrument on board ship and operated under his immediate control.

Furthermore, the ship fitted with a direction-finder is enabled to take bearings upon the transmissions from other ships; and at least one instance can be quoted in which a ship in distress, after signalling its inaccurately estimated position, has been found at a position one hundred miles away by means of a direction-finder on the rescuing ship. A possible future development of the ship direction-finder is the provision of a safeguard against

collisions at sea in times of thick fog

(c) Conditions for Freedom from Night Errors.— It is now well known that wireless direction-finders, even in the most favourable situations, are subject to a variable error under certain conditions of transmission, which chiefly occur at night. These errors are due to the reception of waves deflected in the upper atmosphere, which therefore arrive at the direction-finder travelling in a downward direction So long as these waves are polarised with their electric force in the vertical plane of propagation, the true bearing will be read off on the direction-finder But if, as is frequently the case, the plane of polarisation of these waves is rotated, then the resultant magnetic field produced at the earth's surface will not be perpendicular to the plane of propagation and an apparent error will be recorded on the instrument.

The actual value of the error will depend upon the relative magnitude of the down-coming waves and the waves transmitted directly along the earth's surface, since it is determined by the direction of the resultant magnetic field due to both sets of waves Close to the transmitter the ground wave predominates and no error is produced. At a distance of about 30 miles overland, the strength of the ground wave has become reduced, and the angle of incidence and relative strength of the downcoming wave have increased sufficiently to introduce an appreciable error in bearing at night. Fortunately for marine navigation, however, the attenuation of the ground wave is much less when travelling oversea, and the downcoming wave does not become effective until the distance from the transmitter is about 80 miles Thus when, as is usually the case, the ship's direction-finder is operated on transmissions which are entirely across the open sea, the bearings are equally trustworthy by day or night up to distances of 80 to 100 miles.

#### FIXED BEACON STATIONS.

Concurrently with the development of the radio direction-finder on board ship, the United States

lighthouse authorities have proceeded with the establishment of radio beacons, or fixed transmitting stations which send certain code signals automatically when once set in operation. number of these stations are already working, and others are proposed or in course of erection. The majority are located on light vessels or near shore lighthouses in the vicinity of the chief harbour entrances, but others are situated on the Great Lakes in the north of the United States. Each station has a characteristic signal easily recognised by an untrained ear and distinctive from any other in the vicinity, and all the stations are clearly marked on charts at points well known to navigators, so that a radio bearing can be definitely identified and plotted on a chart with the same facility as a visual bearing.

It is interesting to note that while the number of British ships fitted with direction-finders is considerably greater than that of any other country, there was, until recently, no fixed radio beacon in the British Isles officially working for the use of these ships. Quite recently, however, the first of a general scheme of fourteen wireless beacons has been erected at Round Island, in the Scilly Islands, by the Trinity House authorities Other beacons are in course of construction at Lundy Island and the Casquets. The Round Island beacon, now in operation, is situated near the lighthouse and employs a simple valve transmitter of moderate power working to an ordinary open aerial. The running of the station is entirely automatic, even to the replacement of the transmitting valves in case of failure; and the installation is maintained in working order by the staff of the lighthouse.

### DIRECTIONAL TRANSMISSION.

(a) The Beam System.—In recent years the arrangement of groups of antennæ and reflector wires to give a concentrated beam of radiation has been developed to a considerable extent and is now coming into extended use for long-distance communication. If such a beam is made to revolve about a vertical axis, the device becomes analogous to a lighthouse, and signals are detectable at a distance only as the beam flashes past the receiver. By arranging a code of signals in such a way that they are transmitted automatically in succession as the radiating system rotates, then a vessel at sea would, in any position, receive a distinctive signal from which its bearing from the transmitter can be immediately ascertained. In order that such a scheme may be realised in practice, it is necessary that the dimensions of the aerial and reflector system shall be made reasonably small, which implies that the wave-length is correspondingly short. Up to the present, two stations have been equipped with such rotating beam transmitters; the first at Inchkeith, in which a parabolic reflector was used, and the second at the South Foreland, at which the antenna and reflector systems were in the form of plane grids or curtains. The wave-length employed was in the neighbourhood of six metres, and the limited range obtainable, together with the necessity of providing special short-wave receivers on those ships using the device, have probably accounted for the un-

popularity of the system

(b) Rotating Loops. — An alternative method of directional transmission is to invert the directionfinder, and set up a closed loop or frame-coil, supplied with oscillatory current from a suitable transmitter. If the loop be rotated uniformly about a vertical axis, then the signal obtained at a distant receiver will vary according to a cosine law, passing through a zero or minimum when the plane of the loop is perpendicular to the direction of transmission. The orientation of the loop at this minimum signal position can most easily be deter-A characteristic mined by a timing method. signal is emitted when the minimum radiation from the loop is in either the north or east direction, and by measuring the time interval between the reception of this signal and the passage of the signal through its minimum intensity, the bearing of a distant receiver from the transmitter can be easily obtained. Other and somewhat more complicated methods of deducing the bearing have been suggested, and consist in imparting to the radiation some characteristic which depends upon the orientation of the loop; for example, the wavelength may be varied continuously during rotation.

The rotating loop transmitter used with a timing method has been developed to a high degree in Great Britain by the Air Ministry, and its applicability to marine working is now under investigation. The method has considerable attractions, in that it can be operated on the wave-lengths usually employed in ship and aircraft communication, and in merely requiring at the receiving end a suitable watch and the ordinary type of wireless receiver. A further advantage hes in the fact that the directional part of the system is located in a fixed

position on the ground, and that the observed bearings are independent of the direction in which the ship or aircraft is pointing, and are almost entirely immune from any disturbing conditions local to the receiver. It is therefore likely that this method will play an important part in the future of navigation wireless.

(c) Course Setters.—In concluding this survey, brief mention may be made of the so-called wireless course setter The use of the directional transmitter has considerable advantages for the navigation of aircraft in that it can be installed at the home station, and the aeroplane has then merely to fly on a constant bearing line to arrive at its destination. To assist in this object an arrangement of a pair of loop transmitters was devised some years ago in Germany, the loops being identical and fixed together at some convenient angle. The loops may either be excited alternately at intervals of once a second, or they may be excited together, but each loop is arranged to emit a Morse signal which is complementary to that

given by the other

When the receiver is located on a line bisecting the angle between the loops, both signals will be received of equal intensity and will thus be indistinguishable from each other. On either side of these bisecting lines the signal from one loop will predominate over that from the other. while such a scheme is only available over definite courses or air routes, it has the advantage over other directional methods in requiring no special apparatus or timing arrangements, and it gives an immediate indication of any departure from the course caused by drift from wind or tide. Such a method has received considerable attention in America, where it is proposed to establish a network of wireless beacons along the main civil aviation routes.

# Obituary.

#### SIR WILLIAM GALLOWAY.

THE death of Sir William Galloway, which occurred at his home in Cardiff on Nov. 2, removes an outstanding figure in the development of scientific coal-mining. Galloway made a number of important contributions to methods of coal-mining, but he will chiefly be remembered as the originator of the theory, now everywhere accepted, that the great explosions which used, in the absence of proper precautions, to sweep through the roads and workings of collieries, are due to the combustion of coal-dust raised into the air.

Galloway was born in 1840, and belonged to a well-known family associated in the west of Scotland with coal-mining and engineering enterprises. After studying at Giessen, and later at University College, London, he became a junior Inspector of Mmes, first in Scotland, and afterwards in South Wales. His attention was thus directed to the causes of explosions He soon saw that the theory then everywhere accepted, that the great explosions are propagated by the combustion of

fire-damp, was quite incapable of explaining the actual facts; and in a series of papers published in the *Proceedings of the Royal Society* between 1875 and 1887, he formulated and supported the coaldust theory. His conclusions were derived mainly from an analysis of the evidence afforded by actual explosions, and the demonstration from this that fire-damp could not have been present in appreciable proportion along most of the track of each explosion. The rest of his evidence consisted in the results of experiments on the surface in a gallery constructed for the purpose at a South Wales colliery controlled by his friend and countryman, Mr. A. Hood.

At first Galloway was only able to obtain ignition of a coal-dust cloud when about 1 per cent. of firedamp was present in the air, but later he succeeded without the addition of fire-damp. The gallery was too short for the development of the extreme violence often displayed in underground explosions, and it was only in the long experimental gallery built in 1905 at Altoft's Colliery under Sir William Garforth's supervision by the Coal

Owners' Association, that a coal-dust explosion was obtained of sufficient violence to blow the gallery to pieces, and hurl masses of the boiler-plate of which it was constructed five hundred feet into the air.

For many years Galloway's conclusions were received with almost universal scepticism. The idea that colliery explosions are simply due to firedamp was firmly rooted. It was, moreover, known that blasting with ordinary gunpowder was commonly carried out with impunity at working faces, provided that fire-damp was absent, though much coal-dust might be present. Owing to the conflict between his views and those of senior colleagues, he had to resign his position as inspector of mines. Gradually, however, confirmation came from other mining engineers or scientific investigators, and particularly from junior inspectors of mines, among whom the brothers W. N. and J. B. Atkinson and Mr. Henry Hall took a leading part. Meanwhile, Galloway held for many years the chair of mining at University College, Cardiff. He also became a well-known consulting mining engineer, and remained so until his death, retaining his activities and scientific interests to the last.

Galloway never tired of urging the necessity of precautions against coal-dust explosions. He laid most stress on keeping the roads wet, and providing dust-proof underground waggons; but he also pointed out, and proved by experiment, that the dust could be made safe by the addition to it of inert material. The latter precaution, independently initiated and vigorously developed by the late Sir William Garforth, has turned out to be practicable and effective; and our knowledge of the conditions under which coal-dust explosions occur, and what is necessary to prevent them, has advanced rapidly in recent years, a great part of the advance being due to the experiments carried

out under Prof. Wheeler's supervision at the Experimental Stations at Eskmeals, and later at Buxton.

The death-rate from colliery explosions in Great Britain has been reduced to about a tenth of what it was when Galloway began his work. No better tribute than this could be paid to the inherent value of that work, since it is the attention which has been paid to the dangers from coal-dust that has brought about the reduction. But even if he had turned out to be wrong about coal-dust, those who knew him would still have loved and respected him for the greatness of his character. J. S. H.

THE memorial address on Prof. O. Wiener delivered by Prof. L. Weickmann before the Academy of Science at Leipzig on July 1 is reproduced in the Berichte of the Academy for that date. Otto Wiener, the son of Christian Wiener, professor of mathematics in Karlsruhe, was born on June 15, 1862, and after leaving school became a student in Karlsruhe, Berlin, and Strasbourg in succession. At Strasbourg he was associated with Kundt, and obtained his doctorate in 1887 with a thesis on the measurement of the thickness of the thin metallic films used by Kundt in his work on the passage of light through metals After acting as assistant in Strasbourg and in Aix-la-Chapelle, Wiener was appointed professor at the latter in 1894, and at Glessen in 1895. After building a new physics institute there, he was appointed to Leipzig in 1899 and built a still larger institute, which was opened in 1905. He had much to do with the establishment of aeronautical and meteorological departments at Leipzig, and more recently was engaged in developing a kinetic ether theory of the universe. He is, however, best known for his optical researches. He died on Jan. 18 last.

#### News and Views.

On Tuesday, Nov 15, M. Paul Pamlevé, professor of celestial mechanics at the Sorbonne, and French Minister for War, gave an evening discourse at the Royal Institution before a large audience M. Painlevé's lecture took the form of a general review of the evolution of scientific conceptions on the structure of matter from the early speculations of Greek philosophers down to the most recent and advanced theories. He pointed out that this problem resides essentially in a change of scale, and put the question as to whether matter would appear continuous or discontinuous if our senses were refined far beyond the range of our most powerful instrument—the famous controversy of plenum versus vacuum turn, continuity and discontinuity have seemed to prevail as an explanation of matter and of light. The atomic theory, and the corpuscular emission of light on one hand, and on the other hand thermodynamics and the theory of luminous waves, are characteristic of these two tendencies. Turning to the question of the reality of molecules, M. Painlevé referred to the great number of very diverse methods agreeing to a remarkable degree of accuracy in their result as to the number of molecules in a unit weight, and mentioned in this connexion the researches of Prof. Perrin on the Brownian movement. He then dealt with the atomic microcosm, showing that the study of corpuscular radiations forces us to introduce the idea of discontinuity inside the atom and to regard all matter as made up of two final elements onlythe electron and the proton. Towards the end of the lecture, M. Painlevé mentioned the difficulties which he in the way of explaining the luminous spectra emitted by atoms, and expressed the hope that the new mechanics, by associating material corpuscles with these mysterious waves, would ultimately overcome those difficulties. He showed a series of interesting slides illustrating points which he had discussed in his lecture, such as atomic impacts and coloured regions with well-marked outlines indicating differences of molecular thickness in soap films. The audience frequently expressed appreciation of the lecturer's eloquent exposition of his subject.

On Thursday, Nov. 17, M Paul Pamlevé lectured at the Institut Français du Royaume-Uni in Cromwell Gardens, South Kensington, on "Absolu et Relativité," under the charmanship of Lord Askwith, chairman of the Council of the Institut. M. Painlevé emphasised the essentially scientific character of the theory of relativity, which has often been falsely represented as a metaphysical doctrine. He considered it important to distinguish carefully between the scientific theory of relativity and the "transcendental subjectivism, which assumes that our sensations alone are a fact, a reality, and that the universe is nothing but an illusion" Relativity demands the objective reality of the external world. What it does is to deprive time and space of the absolute character with which they have previously been wrongly endowed. They are so closely interconnected in our perception of the universe that we can not realise the absolute except as a combination of them. M. Painlevé went on to discuss the definitions of time and space measures in relation to the principle of casuality, and showed that it is necessary for the relativist to regard the notion of simultaneity of events occurring at different places as a partially relative one. The principle of relativity has introduced simplifications into the electro-magnetic interpretation of Fresnel's optics, but these simplifications require the assumption of a time system special to each observer. This requirement has given pause to many would-be adherents of the theory, while others have thought to find an essential contradiction in the theory. In M. Pamlevé's opmion, the theory is coherent and logically sound. Einstein has given us a view of the universe which entails a revision of the fundamental principles of science but strengthens them enormously.

The Council of the Royal Meteorological Society has awarded the Symons Memorial Gold Medal for 1928 to Prof. Hugo Hergesell, Director of the Aeronautical Observatory, Lindenberg, for distinguished work in connexion with meteorological science medal, which is awarded biennially, will be presented at the annual general meeting on Jan. 18, 1928. Prof. Hergesell has for many years played a prominent part in the development of meteorology. So far back as 1896 he was chosen as president of the International Commission for Scientific Aeronautics; and that Commission continued to organise upper air observations until the outbreak of the War. The data from 1900 to 1913 were published by Hergesell at Strasbourg, and he supplemented the work done there by ascents in widespread regions over the oceans. In 1914 he succeeded Assmann as Director of the Aeronautical Observatory at Lindenberg, which issues the daily weather reports of the upper air for the use of pilots over a large region  $\cdot$  there he has shown very great organising ability, as is indicated by the scientific output of that institution. It has made and published an enormous mass of upper air observations, and has digested and discussed these in an admirable manner. Not only has the Director himself made important contributions to knowledge, but he has also

trained a number of men some of whom have made world-wide reputations by advances of meteorological science. Prof. Hergesell is also editor of the *Beitrage* zur Physik der freien Atmosphare, which he founded with Dr. Assmann

When Prof. J. A. Fleming retired from the chair of electrical engineering at University College, London, which he held for forty-two years, a committee was formed under the chairmanship of Mr. A. A. Campbell Swinton, to present University College with an oil portrait of Prof. Floring, and also to present Prof. Fleming himself with a copy of that portrait. The committee, a very representative one, was fortunate in getting the portrait painted by Sir William Orpen, a former art student at the Slade School, University College. Sir William Orpen also arranged for a copy to be made which the committee intended for Prof. Fleming, who, however, has decided to present it to the Institution of Electrical Engineers. The original will be presented to University College by the committee on Wednesday, Nov. 30, at 5 P.M., and the copy will be presented to the Institution by Prof. Fleming on Thursday, Dec. 1, at 6 P.M., at the ordinary general meeting of the Institution to be held on that

THE amalgamation of the Rontgen Society with the British Institute of Radiology was formally completed at a joint general meeting of members of the two Societies on Nov. 17. Sir Humphry Rolleston was elected president for the ensuing session, with Sir William Bragg, Dr. Kaye, and Dr. Knox as vicepresidents. The president, in his maugural address, referred to the history of the two constituent bodies. and sketched the possibilities of the widened scope of activity which should follow the amalgamation This scope was exemplified in the following day's meetings. In the morning, papers were read on X-ray and radium protection by Dr. Kaye; and on X-ray measurements, by Prof. Crowther, Prof. Hopwood, Prof. Owen, Mr. C. E. S. Phillips, and Prof. Russ. In the afternoon, papers were read on the use of opaque injections as an aid to X-ray diagnosis; Sir J. Purves-Stewart dealing with the nervous system, Sir J. Thomson-Walker with the urmary system, Dr. Burrell with chest conditions, and Dr. Gibbons with gynæcological conditions. The Rontgen Society and the medical society, formerly known as the B.A.R.P, have each contributed much in the past to the progress of the study of radiology and of the application of X-rays and radium in medical practice, their united efforts should secure a mutual acceleration of effect, and it is to be hoped that the result of the amalgamation will be to enhance the status and value of British radiology in all its branches.

The presidential address of Prof. C. H. Desch to the Sheffield Society of Engmeers and Metallurgists, recently issued by the Society, is of unusual type, in that it concerns itself less with technicalities of science than with the geographical and social relations of Sheffield's industry. The treatment shows Prof. Desch's well-known breadth of knowledge and of

understanding. Without pure ores close at hand, in spite of distance from ports, Sheffield has long maintained a high position as a producer of fine quality steel and of cutlery made from it. This position was gained ere coal came into use, and the two main factors at first were water-power from the steeply-falling Don, and charcoal from the wooded slopes. The utilisation of these assets in days when workmen had not as yet been forced to become machine-tenders added another asset, that of traditional skill, an asset of prime importance which the nineteenth century squandered recklessly. Prof. Desch says that the cementation process for making steel is now known to have been a Tyneside invention of the early seventeenth century, but it developed at Sheffield, an example of cultural importation helping forward local relations between men and their environment, and he pleads for deeper study of these relations through the regional survey of Sheffield, which is getting to work. We are happy to note that Prof. Desch is the chairman of the committee concerned, and that the Geographical Department of the University of Sheffield is actively concerned in this valuable effort.

Some aspects of the regime of the Nile are discussed by Dr. H. E. Hurst in the Geographical Journal for November. The problems relating to Lake Tana and the Blue Nile are of special interest at the present moment. The period of greatest importance in the irrigation of Egypt is from March to July, when the Nile is lowest and has to be supplemented by water taken from the niver in December and January and stored in the Aswan reservoir. In April and May. when the Nile is at its lowest, the White Nile contributes 85 per cent. of the total discharge and the Blue Nile only 15 per cent. The portion of the Blue Nile supply which comes out of Lake Tana is only onethirteenth of the total discharge of the Blue Nile. In other words, the greater part of this supply enters the river between Lake Tana and the Sudan. This part of its basin is little known. It is a deep rugged valley in which travel is difficult. At least two large streams enter the Blue Nile within a hundred miles of the Sudan boundary but their discharge has not been measured. Lastly, it may be noted that the White Nile is much more important than the Blue Nile to Egypt, and that it has now been shown that the Sobat and the Lake Plateau contribute about equal parts to the supply of water in the White Nile The lake plateau supplies come mainly from Lakes Albert and Victoria, and the rest from the Semliki and Lake Edward.

The essential features of several types of metallurgical photomicrographic apparatus were described in an article in Nature of Oct 8. We have since had an opportunity of examining the large metallographic microscope made by Leitz of Wetzlar. The component parts of this apparatus are mounted on saddles which are capable of being moved along an optical bench consisting of a triangular bar similar to that used in two of the instruments referred to in the article. The stage of the microscope

consists of a right-angled casting screwed to the slide which is operated by rack and pinion at one side of the upright carrier. Two novel devices are incorporated in the camera of the Leitz instrument. The camera front has a small observation mirror at one side through which the entire area of the focussing screen can be seen. This is useful when the preliminary focussing and adjustment of the illumination are being made By means of it also the image may be watched during the actual exposure. The other device consists of a telescopic magnifier which is fitted into one side of a box attachment at the end of the camera and is in such a position that the fine adjustment screw of the microscope is within reach of the hand when the operator is looking into the magnifier. With the aid of the magnifier the image may be finally focussed. even after the plate carrier has been inserted, by examining it on a projection screen which can be brought into position immediately in front of the plate carrier. These devices enable the operator completely to control the focussing without having to move from the side of the apparatus.

In a paper on "Technical and Non-technical Management," read recently before the British Section of the Société des Ingénieurs Civils de France, Mr. Lucien A. Legros emphasised the dangers which may occur when industrial concerns are managed by persons without adequate technical knowledge. Management is usually divided into technical and non-technical departments, the former responsible for the processes of production and control of the employees and the latter concerned with the commercial side of the business. In most firms, Mr. Legros points out, there is a growing breach between the two functions of management, and there is a marked tendency for the technical side to become subordinate. But unless responsibilities are correctly allotted, and unless difficulties are mutually appreciated, management is not likely to be efficient. As it is, technical men have no commercial training, while non-technical managements have little knowledge of the conditions of the employees and of the relative values of skill, brawn, and brains, and do not appreciate the importance of research, standardisation, and technical education. Mr Legros admits that there are many difficulties in the way of coordination. In a few cases, the representation of technical employees on the Board of Directors might prove useful, though 'works committees' would, he considers, in general be a better solution provided they are independent of both employers' federations and trade unions. Indirectly, 'welfare work' may also be of importance. Mr. Legros concludes that if production is to be increased, technical education must be reformed and apprenticeship improved, while the real wants of the large but silent majority of the workers-stability of employment, immunity from 'rate cutting,' increased facilities for approach to the management, promotion through ability, and good foremanship-will have to be considered by non-technical managers.

An article by E. G. Fischinger in the Elektrotechnische Zeitschrift for June 2 gives an interesting history of one of the earliest high-tension lines in Europe. The power is generated at Luachhammer in Prussia and is transmitted at a pressure of 100,000 volts to the rolling mills at Riesa. It began working in January 1912. The chief difficulties encountered were with transformer breakdowns. After being in operation for some time, the mutual forces between the coils loosened them and the constant rubbing chafed away the insulation and caused short circuits. The strings of insulators supporting the high tension wires also caused trouble. This was traced to unequal expansion caused by heating and cooling, which developed cracks in the surface of the porcelain. This difficulty was overcome by using insulators of a new design. Like similar lines elsewhere, interruption of the supply was sometimes caused by large birds alighting on the wires and being electrocuted. In the south of France and in Switzerland, many eagles, large owls, and other birds of prev and capercailzie have been electrocuted by overhead high tension wires. Short circuits can be caused in this way. The author states that in the early days no less than thirty buzzards were electrocuted in rapid succession. He naively adds that after this the birds learned to keep away from the wires and there were no more short circuits. In our opinion, this diminution in the number of large birds, some of which are useful vermin killers, is much to be regretted. More thorough precautions should be taken to prevent such accidents. Other difficulties arise from the mechanical oscillations sometimes set up in the lines and from the ice formed on them in cold weather. The latter is easily got rid of, however, by slightly raising the temperature of the wires by sending an electric current through them.

In the Quarterly Review for October, S. L. Bensusan gives a survey, based on personal investigation, of current agricultural conditions in England. While he admits that in many cases the farmer is suffering through no fault of his own, he considers that where natural conditions are at all favourable, the best men are either holding their own or making small profits. Failure to realise the transitional nature of the industry accounts for the losses of most of the unsuccessful farmers, the situation being aggravated by the pessimistic attitude adopted by the press and others. He points out that the real solution lies in the development of new fields of activity, newer varieties of wheat, for example, being a safer remedy than the raising of a tax on imported flour. Sugar beet, he considers, offers the most hopeful prospects at the present time and serves a double purpose in that it relieves unemployment by creating labour both in field and factory. However, the financial assistance from the Government is largely responsible for the present success of the industry, so that the farmer must be able to increase his yield per acre and also to ensure that he receives a fair price from the factory before he can hope to compete with foreign countries. Amongst other changes quoted are those concerned

with stock, the methods now in use being uneconomic and not supplying the real needs of the market. Baby beet, small readily matured mutton and standardised pigs are the lines upon which the farmer must develop if he is to keep abreast with modern demands. Milk production should be one of the most profitable industries, particularly since the new methods of intensive grass farming have proved so successful.

It is announced that Mr. John D. Rockefeller, Jr., has offered to the Government of Palestine a sum of 2,000,000 dollars for the building and maintenance of a museum in Jerusalem if the Government will provide the site. The offer has been accepted by Lord Plumer on behalf of the Palestine Government. One of the conditions of the gift is that the museum should be purely archæological. Stops are now being taken to expropriate a site known as Karm esh Sheikh, which is outside the walls near the north-east corner of the walled city and opposite Herod's Gate. This munificent gift will provide a much needed relief from the present madequate accommodation.

Mr. Thomas Alva Edison has been elected an honorary member of the Institution of Electrical Engineers.

THE Council of the Yorkshire Philosophical Society has elected Mr. C. Tate Regan, Director of the British Museum (Natural History), and Dr F. A. Bather, Keeper of the Department of Geology, British Museum (Natural History), as honorary members of the Society.

SIR CHARLES CLOSE, formerly Director-General of the Ordnance Survey, has been appointed by the Council of the Royal Geographical Society, president of the Society until the anniversary meeting in June next in succession to Dr. D. G. Hogarth, who died on Nov. 6.

The Wellington (N.Z.) correspondent of the Morning Post announces that Dr. R. J. Tillyard, chief of the biological department, Cawthron Institute, Nelson, New Zealand, has been appointed chief entomologist to the Commonwealth of Australia. He will still remain in charge of the Empire Marketing Board's research work against the blackberry pest in New Zealand.

The Secretary for Mines has appointed the following to be a Committee to report to the Safety in Mines Research Board from time to time on, and to superintend research required for, the improvement of mine rescue apparatus and equipment: Mr. Robert Clive (chairman), Mr. James R. L. Allott, Mr. (f. L. Brown, Dr. J. S. Haldane, Mr. W. E. T. Hartley, Mr. P. S. Hay, Prof. J. A. S. Ritson, Mr. J. H. Thorne, Dr. R. V. Wheeler, and a representative of the Chemical Warfare Research Department. The Secretary of the Committee is Mr. E. A. Shearing, of the Mines Department, to whom all communications on the subject should be addressed.

THE library of the late Sir Arthur E. Shipley is to be sold by auction at the Corn Exchange, Cambridge, on Tuesday next, by Messrs. Catling and Son, 6 St.

Andrew's Street, Cambridge. Among the items to be offered are long runs of scientific series and serials. Catalogues are obtainable from the auctioneers.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:-An assistant master at the Wycombe Technical Institute mainly for mathematics and physics or engineering science—The Principal, The Technical Institute, Wycombe, Bucks (Nov. 28). A public analyst for the Borough of Lewisham-The Town Clerk, Lewisham Town Hall, Catford, SE.6 (Nov. 29). Inspectors under the Agricultural Wages (Regulation) Act, 1924 -The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Nov 30). A student probationer at the Millport Marine Station, Cumbrae, Buteshire—The Secretary, Scottish Marine Biological Association, 88 Bath Street, Glasgow (Dec. 3). A chief engineer to the Manchester Steam Users' Association —The Executive Committee, Manchester Steam Users' Association, 9 Mount Street, Albert Square, Manchester (Dec 6). A woman blochemical research assistant at the Low Temperature Research Station, Cambridge; also two laboratory assistants, one for routine storage experiments, physical measurements, etc., and one for chemical analyses of animal tissues, preferably with working knowledge of bacteriology The Superintendent, Low Temperature Research Station, Downing Street, Cambridge (Dec 10). A headmaster of the Heaton Secondary School for Boys, Newcastle-upon-Tyne - The Director of Education, Education Office, Northumberland Road, Newcastleupon-Tyne (Dec. 17). A plant physiologist and a plant pathologist for banana research at the Imperial College of Tropical Agriculture, Trundad, B.W.I.—The Secretary, Imperial College of Tropical Agriculture, 14 Trinity Square, E.C.3 (Dec. 30). A woman assistant lecturer in the Department of Hygiene and Public Health of the Battersea Polytechnic—The Principal, Battersea Polytechnic, S.W.11. A junior research metallurgist at the Mond Nickel Company, Ltd. - The Secretary, Research and Development Department, The Mond Nickel Company, Ltd., Victoria Station House, S.W.1.

# Our Astronomical Column.

DISCOVERY OF A NOVA.—A new star of the tenth magnitude was discovered at Bergedorf Observatory by Prof. Schwassmann and Dr Wachmann on Nov. 18 at 11 P.M. in R.A. 5h 15m 12s, N. Decl 16° 38′. The position is in Taurus, close to the boundary of Orion, 9° east of Aldebaran, and about 12° from the middle of the Milky Way.

New Comet.—A new comet, the ninth of the year, and therefore designated 1927 j (the letter i is usually omitted in this connexion, to avoid confusion), was discovered by Dr. Schwassmann and Herr Wachmann at Bergedorf Observatory on Nov. 15 at 21<sup>h</sup> 33 3<sup>m</sup> U.T., in R.A. 1<sup>h</sup> 32<sup>m</sup> 12<sup>s</sup>, N. Decl. 20° 53′, Daily motion—24 sec., south 2′, magnitude 14; the announcement was made by the I.A.U. Bureau at Copenhagen.

Assuming uniform motion, the new comet's position on Nov 26 is R.A. Ih 28m, N. Decl. 20° 30′, about 5° west of Beta Arietis; it crosses the meridian about 8.48 P.M., at an altitude of 59°, and is thus very well placed for observation. Its slow motion suggests (but does not prove) that it may be at a considerable distance from sun and earth, in which case there is a fair prospect of its brightness increasing. It is sufficiently near the ecliptic to lie within the zone covered by minor planet photographs, and presumably it was incidentally discovered in the course of minor planet work; but as the telegram contains no expression of doubt, it may be assumed that the image is of a decidedly cometary character.

The Return of Encke's Comet.—This, the best known of all the short-period comets, was detected by Prof. G. van Biesbroeck at Yerkes Observatory on Nov. 13d 1h 19m 5 U.T., m R A. 22h 57m 8s·2, North Decl. 8° 54′ 13″; mag. 16. Perihelion will be passed in 1928 on Feb. 19·71 U.T., the other elements being, according to L. Matkiewicz (Astr. Nach., No 5521),  $\omega$  184° 55′ 43″ 20, i 12° 31′ 53″·43,  $\Omega$  334° 33′ 56″·43,  $\phi$  58° 9′ 27″·57, period 3·286435 years, equinox 1927·0. The comet is at present too famt for ordinary observors, but it should be visible with small instruments in the evening sky in January. After that it goes south, and must be left to southern observers.

This is the thirty-seventh observed apparition of the comet, a much larger number than that of any other comet; Halley comes second with twenty-eight. Encke has not been missed at a single return since 1819,

It is the eighth comet detected this year, and so bears the designation 1927 h; four of the eight were expected periodic comets, the other four were unexpected ones, though one of them (Gale) has proved to be a short-period comet.

SUNSPOT RECORDS FROM ARIZONA AND CALIFORNIAN TREES.—Some years ago, Mr. A. E. Douglas noted that a correlation could be traced between the sunspot curves and the size of the annual rings in the great trees of California. Since the tree records are available for thousands of years in the past, it is possible, once the relationship is established, to carry back the sunspot record into periods for which no data were formerly available. It will be remembered that Mr. E. W. Maunder noted a long period at the end of the seventeenth and beginning of the eighteenth centuries in which sunspots were exceedingly scarce, and the eleven-year cycle seemed to be in abeyance. Some people even suggested that the cycle might not have existed until the eighteenth century. The tree record gives new information on this point.

An article by Mr. Douglas in Jour. Roy. Astron. Soc. of Canada for September discusses the records of a number of Arizona pimes. He states that he had noticed the flatness of the curve of sunspots as given by the trees at the period noted by Mr. Maunder before he saw the conclusions of the latter. Carrying the research further back, he has found other periods at which spot activity seems to have been temporarily suspended. Between 1000 B.c. and 300 B.c. activity was slight, then a more active period began. There were other lulls between A.D. 400 and A.D. 650, and between A.D. 900 and A.D. 1200. In the same number, Mr. R. E. De Lury discusses some fossil trees, the estimated age of which is 300,000 years, and shows that the eleven-year period was then in evidence.

This study also affords evidence of the close correlation between sunspots and weather that exists in some districts of North America; in Great Britain the correlation is much less evident, if it exists at all.

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# Research Items.

THE DOUBLE AXE IN ETRURIA. -In Man for November, Mr. J. A. Spranger has noted examples of the occurrence of the double axe in Etruria in vase paintings, emerary urn reliefs, on bronze mirrors, as votive offerings, on coins, in tombs, and on a grave stele, with the view of their throwing light upon the Ægean or Asiatic origin of the Etruscans. It has, however, to be borne in mind that the occurrence of the cult does not necessarily mean that they brought it with them ab initio; it may have been introduced later in the course of their wide commercial relations. The evidence is by no means extensive, and, further, any conclusion must be tentative and hable to be upset by further discoveries. It would appear that the double axe was known from early Etruscan times, as is shown by the unique grave stele in the Florence Museum,—the oldest inscribed Etruscan monument known, and the only one bearing an unmistakable double axe. Further, the later Etruscans were aware of its value as a symbol of Dionysus, and a weapon connected with sacrificial rites. It is, however, at Vetulonia that the best evidence is found of its symbolic value, where it occurs as an emblem of power with the iron fasces in "the Tomb of the Lictor." Yet nowhere does it occur as a cult in the Cretan sense. It is rather evidence of 'Mycenæan' culture affecting the ancestors of the Etruscans.

Obsidian.—In Ancient Egypt for September, Mr. G. A. Wainwright discusses the possible sources of the objects made of obsidian which have been found in ancient Egypt. As obsidian or volcanic glass is found only in certain areas, its presence in a nonvolcanic country is a proof of trade communication. Unfortunately, it is not at present possible to identify positively by petrological tests the place of origin of any given piece of obsidian. Hitherto it has been generally thought, and almost universally the tendency among anthropologists to conclude, that obsidian in early times came from Melos; but it has also been recognised by some that other sources are possible. The abundant use of obsidian in Armenia and Mesopotamia militates against a Melian origin. Not only has obsidian been reported to occur in quantities in Armenia, but also the distribution of finds of obsidian implements in Armenia and Eastern Asia Minor and its relation to the distribution of flint implements, points to Armenia as a centre of use, with a peripheral contact with flint, where obsidian and flint are used side by side, until the flint entirely takes the place of obsidian. With this the distribution of obsidian in western Asia also well may be taken to agree. The farther from Armenia the rarer obsidian becomes, until in Anau, Turkestan, Palestine, and Egypt it becomes a rarity. other hand, its frequency in Mesopotamia, which is thus an exception in the peripheral distribution, may be accounted for by the facility of communication with Armenia by the river system. Several considerations equally point to an early connexion between the north and Egypt through Syria, such as, for example, the origin of barley, wheat, and the vine in Syria, or in the case of the last named, perhaps Armenia; as well as the intrusion of 'Armenoids' into Egypt in predynastic times. Armenia, therefore, rather than Melos, is the probable source of the Egyptian obsidian, communication being also easier in this case than with the Abyssinian obsidian fields.

Norwegian Decapods —Mr. James A. Grieg ("Decapoda Crustacea from the West Coast of Norway

and the North Atlantic." Bergens Museums Aarbok, 1926 Naturvidenskabelig rackke No. 7), records some rare decapeds obtained recently from the west coast of Norway and also gives a list of decapods collected by the Michael Sars between 1900 and 1914 during her expedition along the Norwegian coast and in the North Atlantic. There is not much system in the list, for we have Porcellana, Eupagurus, and members of the Thalassinidea sandwiched in, for apparently no reason at all, between species belonging to the Brachyura. It is interesting to compare these records with the British fauna. Eurynome aspera appears to be very rare, also Stenorhynchus longirostris, Inachus dorsettensis and I. dorynchus. Many other common British species apparently occur only occasionally in Norway. All breeding specimens are recorded, making these notes really valuable for reference. Amongst the four species of Pasiphæa, P. multidentata Esm. is well represented in the fjords, and it is shown that it is in berry from January to September, the breeding season thus spreading over a long period, for mature eggs occurred both in March and September, possibly showing two breeding seasons. Among the rare deep-water forms in the young fish trawl collected by the Armauer Hansen was one specimen of that peculiar crustacean Eryoneicus faxoni Bouv., 32 mm. long, which has been shown by Sund to be almost certainly the young of Polycheles sculptus Smith.

TRANSLOCATION IN THE COTTON PLANT.—Problems of vital interest to cotton growers are investigations of the factors regulating the shedding of buds and young bolls, the variations in form and development of the cotton plant from climatic and other causes, and the condensation of sugar to form cellulose in the lint hair. T. G. Mason and E. J. Maskell, of the Trinidad Cotton Research Station, have tried to elucidate these special problems by investigating the wider general problem of the translocation of nutritive substances in the cotton plant, and their local distribution to leaves, roots, flowers, seeds, and limb (Empire Cotton Growing Review, vol 4, No. 4). Their results confirm in part some obtained for other species by Prof. O. F. Curtis, of Cornell University. A strain of Sea Island cotton was used in the experiments, and the work consisted essentially in the analyses of samples of leaves, stems, and bolls collected at specified times from plants treated in certain definite The bark and wood were analysed separately. It was found that in the leaf both sugar and reserve carbohydrate fluctuated markedly, the quantity rising during the day and falling during the night. In the bark there were well-marked changes in total sugar concentrations, which followed closely on those of the leaf, with a lag of about two hours. No appreciable diurnal fluctuations could be demonstrated in the case of the wood, either in total sugar concentration or in reserve carbohydrate. Diurnal changes of sugar concentration in the holl were similar to those in the bark. The effects of ringing shoots were very marked. Above the ring sugar concentra-tion rose rapidly; below the ring the concentration fell as rapidly. In further investigations on the particular channel of transport, it was found that sugar continued to pass down a stem through a region in which bark and wood were separated by a ring of paraffined paper, and would also pass down into a seven-inch flap of bark continuous with the bark of the stem at its upper end, but separated from the wood throughout the whole of its length. The authors conclude that the bark forms the main channel of longitudinal transport.

Soil Sterilisation.—The Ministry of Agriculture has issued an illustrated leaflet (No. 209) describing practical methods of soil sterilisation for glasshouse crops. Although such treatment of the soil was formerly considered an expensive luxury, the modern grower has come to regard it as a necessary form of insurance, the question now being which method is the best to adopt. The two principal agents suitable for soil sterilisation are heat (steaming or baking) and chemical compounds such as cresylic acid Special attention is paid in the leaflet to the former, as it is shown to be both more effective and economic. Small quantities of soil may conveniently be sterilised by baking, the best results being obtained if the soil is in good condition and reasonably moist when treated, and is then stored for six weeks before being planted. Overbaking renders the soil infertile. Steaming, however, is the more usual method of treating the soil, and many ways of applying it are described with several illustrations. The choice of the steaming method must depend on the degree of soil sickness, as some allow of a deeper penetration than others. Eel-worm trouble, for example, cannot be eradicated by a superficial steaming. A repetition of the treatment is recommended every four years if a satisfactory standard is to be maintained, and sterilising should be completed by the middle of January, as it is advisable to flood the soil after steaming, and sufficient time must be allowed for it to dry before the crop is planted. Preparation of the soil before treatment is essential for success; dry, open soils steaming better than wet ones. Nitrogenous manures should not be applied to recently steamed soil unless it is in very poor condition, as the treatment induces an accumulation of nitrogen. A dressing of potash, and occasionally of phosphate, however, may be given with advantage. With regard to chemical treatment, cresylic acid is the most usual agent employed, but it is much less effective than steam, owing probably to the difficulty of obtaining such intimate contact with the soil particles. Further, it is necessary to apply the acid annually, so that the higher cost of steaming is approximately counterbalanced by the less frequent applications required. Emphasis is laid on the necessity for care in all soil-sterilising operations, as the work is rendered useless if the proper precautions are neglected.

'EDELMIST,' A NOVEL FORM OF FARMYARD MANURE. -An illustrated account of a new method of making farmyard manure, which has aroused considerable interest amongst farmers in Central Europe, is given by A. Cunningham in the Scottish Journal of Agriculture (vol. 10, p. 434). The manure produced by this process is known as 'Edelmist,' and is claimed to be superior to dung produced in the usual way even under the best conditions The chief feature in its preparation is that active fermentation is encouraged during the early stages, the dung being piled up loosely in shallow layers to secure the most favourable conditions for aeration. When the temperature has risen to 55°-65° C, the heap is thoroughly compacted by tramping, covered with a loose layer of fresh dung and allowed to remain untouched for 3 or 4 months. Several advantages are claimed as a result of the fermentation process, the most important being the - fact that the easily decomposable organic constituents of the straw are broken down, so that any retardation in the rate at which the nitrogen becomes available to the plant is avoided. Further, the high temperature is probably fatal to weed seeds and plant or animal pests. The tramping which follows the fermentation stage results in the exclusion of air, and in consequence the manure contains relatively few organisms, and can therefore be stored for some

length of time without suffering from undesirable changes. The losses incurred during the making of Edelmist are quoted as about one-half those of farmyard manure. The results of field experiments are somewhat variable, but the superiority of Edelmist over ordinary dung seems clearly indicated. The process is protected by British patent, the patentees providing plans for dungsteads, the cost of which they estimate would be repaid in from 3 to 5 years. Although the present results are quoted from Germany, where the farming conditions are somewhat different from those in England, yet the Edelmist process must be regarded as a distinct advance on the ordinary, and often very unsatisfactory, methods employed in the storage of dung in Great Britain.

RAINFALL IN BELGIUM.—It is satisfactory to note that the military occupation of Belgium from 1914 until 1918 did not result in the complete disorganisation of an important undertaking in the way of chmatological research that had been begun in that country in 1909. In that year, a simple uniform system of rainfall measurement was organised with the object of obtaining a long series of daily observations which would enable the normal rainfall for each month of the year over the whole country to be obtained. Thanks largely to the efforts of J. Vincent, the number of observers supplied with standard instruments had reached 311 by the end of 1913. This number may seem small compared with the five thousand which represents roughly the number of contributors to the British Rainfall Organisation. It was reduced, moreover, to a bare hundred by the end of 1918. Nevertheless, this network has been found to be sufficiently close to determine the general characteristics of the rainfall of the country as a whole. The records for the seventeen years 1910 to 1926 have been utilised for this purpose by E. Vanderlinden, and the results of his researches appear in Vol. 2 of the Mémoires de l'Institut Royal Météorologique de Belgique under the title "Sur la distribu-tion de la pluie en Belgique." In addition to ordinary monthly means for these seventeen years, corrected means are given which allow for the fact that these years were mostly characterised by rainfall m excess of the average for the forty years 1887-1926, judging from the records made at Uccle. The monthly means show that most rain falls in the southeast, where the highest ground is situated. It seems clear that the moist winds from the Atlantic yield up more of their moisture here than on the low ground discussion of the abnormally dry weather from Aug. 1920 to Oct. 1921, a drought apparently without precedent in Belgium in historic times. In this connexion accounts are given of all notable droughts of which records have been found since the year 1245. Some figures with regard to the maximum intensity of ramfall are worthy of note. They include a fall of 25 mm. in six minutes at Turnhout on July 10, 1889, and 200 mm. in three and a quarter hours at Louvain on May 14, 1906.

Testing Iron by means of Ring Specimens.—In practical work it is usual to make the ratio of the radial thickness of a ring specimen to its diameter to be about a tenth. In this case the average magnetic force on the inner circumference of the ring is about ten per cent. greater than at the outer circumference. In general, therefore, an error is introduced into the results owing to the distribution of the magnetic flux not being uniform. M. G. Lloyd, of the U.S. Bureau of Standards, has computed the errors involved for various ratios of radial thickness

to mean diameter on the assumption that the permeability is constant. In the Journal of the Institution of Electrical Engineers, p. 932, 1927. E. Hughes has made computations taking into account the variation in the permeability of the iron over the cross-section. Computing in this way, he finds that the errors given by Lloyd are almost invariably too small or too large. He discusses the relationship between the actual hysteresis loss in the ring and that found by using alternators and by using a ballistic galvanometer. Reference is made to the desirability of using a larger ratio of radial thickness of diameter than is customary, in order that any error due to mechanical strain produced by punching, etc., may be reduced.

STRENGTH OF ELECTRIC LAMPS.—The important paper on the mechanical strength of metal filament electric lamps which was read to Section G of the British Association at Leeds on Sept. 5 by Mr. Murgatroyd is published in Engineering for Nov. 4. The earliest filament lamps used platinum, which has a melting point of only 2028° Kelvin, whereas tungsten, which is now used, has a melting point of 3655° K. From theoretical considerations, Mr. Murgatroyd deduces that a temperature of about 2020 To which the transfer of about 2020 To which the transfer of about 2020 To which the transfer of about 2020 To which the transfer of about 2020 To which the transfer of about 2020 To which the transfer of about 2020 To which the transfer of t 6270° K. would be the most efficient for illumination. He also deduces that the larger the crystals of the metal used in a filament the stronger the filament should be. He says that the size, shape, and orientation of the crystal determines its mechanical strength. Using a simple apparatus he carried out 'shock' tests on electric lamps. He obtained the following An electric filament lamp is weaker mechanically when it is incandescent than when it is cold. Contrary to ordinary ideas, the gas in a gas-filled lamp does not add to its strength. Spiral filaments also are not necessarily stronger than straight filaments. He emphasises that the chief factor in determining the mechanical strength of a metal filament lamp is the structure of the filament material. Since high temperature tends to weaken a lamp, it might be thought desirable to increase its strength by working it at a lower temperature and therefore at a lower luminous efficiency. This, however, would be a retrograde step. The 60-watt gas-filled lamps which he tested when working normally were relatively strong in spite of the high temperature. This fact should encourage the user to insist on higher strength in all lamps without having to resort to uneconomical operation. For low candle power lamps, a squart squirrel-cage type of mounting has many advantages in the present stage of develop-

The Slotted Wing in Aeroplanes.—In aviation a difficulty arises in connexion with the use of slotted wings from the fact that with the slot open the maximum lift usually occurs at an angle of incidence considerably higher than with the ordinary unslotted wing. In order to benefit to the fullest extent from the high lift co-efficient arising from the use of the slot, it has been necessary for the machine to have a high under-carriage, with some discomfort to the occupants both on taking off and on landing. An adjustable rear flap to some extent overcomes this difficulty (Aeronautical Research Committee: Reports and Memoranda, No. 1063 (Ac. 245); Model Experiments on R.A.F. 31 Aerofoil with Handley Page Slot. By H. B. Irving, A. S. Batson, and D. H. Williams.—London: H.M. Stationery Office. 6d. net). When down, such a flap, in effect, increases the angle of incidence of the wings and simultaneously possesses the additional advantage of giving an in-

crease in maximum lift over that provided by the slot.

FLUID VORTICES.- With the object of supplying data for a more complete mathematical treatment of the vortices formed in a fluid about a body rotating m it, or if this should prove impossible, for a qualitative treatment of the problem, Messrs. T. Terada and K. Hattor, of the Aeronautical Research Institute of the University of Tokyo, have made a photographic study of the forms of these vortices under various boundary conditions. Spheres, cylinders, and discs have been rotated in cylindrical and rectangular vessels sometimes alone, sometimes in pairs, with the directions of rotation the same or opposite, and the torque on the outer vessel has been measured. The vortices produced in the liquid show great persistence and accommodate themselves to widely differing boundary conditions, behaving as if they were rings of deformable material possessing a form of elasticity. No hydrodynamic theory has been found capable of covering the whole of the effects observed. The paper appears in the August Issue of the Report of the Aeronautical Research Institute, Tokyo, and is well illustrated by photographs.

VERTICAL ILLUMINATION OF METALLURGICAL SPECI-MENS.—In the Journal of the Royal Microscopical Society for June 1927, Mr. Conrad Beck discusses from an optical point of view the best method of illumination of metallurgical specimens with the vertical illuminator, and, in particular, the method used by Mr. Harold Wrighton, whose photomicrographs showed a resolution of lines about 1/150,000 meh Since the resolution depends on the aperture of the object-glass, the whole aperture must be utilised to make the best use of the magnifying power. This condition cannot be realised when a prism or an opaque reflector is used. To obtain the best results, a transparent reflector is necessary of a size at least as large as the back lens of the object-glass. Other two conditions are shown to be essential for perfect illumination: the light must (1) be centred and (2) be in focus upon the object. To fulfil the three conditions an optical bench arrangement is necessary. One lens is used to produce a suitably sized image of the source, and an iris diaphragm to vary the size of this secondary source. A second lons focusses the diaphragm at a position close to the back lens of the object-glass, whilst a second diaphragm allows the area of the field to be controlled exactly. The arrangement also permits the use of the method proposed by Prof. Carl Benedicks of obtaining various types of oblique illumination by the use of patch stops. The desired effect can be obtained by placing a suitable stop close to the first diaphragm.

THERMAL DISSOCIATION OF CARBONYL Chloride.—Phosgene, or carbonyl chloride, decomposes on heating into carbon monoxide and chlorine, and measurements of the dissociation constant by chemical and physical methods are described by H. Ingleson in the Journal of the Chemical Society for September. The gas was heated in a quartz bulb and the chlorine determined iodometrically or by the rise in pressure measured on a manometer. The results from the two methods agree satisfactorily and the usual straight line relationship holds between the reciprocals of the temperatures and the logarithms of the dissociation constants. The approximate heat of the reaction was found to be 25,500 cal. at 416°, in agreement with the value obtained by Thomsen. The decomposition of carbonyl chloride appears to be catalysed by the chlorine which is formed, and this was first noticed by Christiansen.

the many years it has been customary to test the lineary of telephone receivers and micro-comparisons against instruments selected. The international committee on long-committee on long-commit

in a paper real by Mr. B. S. Cohen to the Instituon of the rical Engineers on Nov 17, a record is and the methods hitherto employed for telephone operators of dime transmission standardisation. He are the subset the new methods and the modifications of the old methods now being introduced. The paper is migrity by ed on the results obtained in the research

Januaratoric, of the Post Office.

Here the adopts a nomenclature used by the Post Office which is becoming standardised. By the volume meant its loudness or amplitude, and by distinction in the reproduction of water and. A distinction is made between articulation and siligibility. Articulation means the compactive of fection in the reception of sounds not conveying bleas, whilst intelligibility means the compactive is rection in the reception of sounds conveying bleas. These depend on the volume and distinction of the sound as well as on external and contact the sound as well as on the sound as well as on the sound as well as on the sound as well as on the sound as well as on

easy to understand what telephone enfrequency is of all the confidence of standard cable. This has become and the transmission unit is now generally, er as the logarithmic ratio of two powers would give.

or of two currents, the former being a logathe base 10 and the latter being to the Napierrandses. It is proposed to call the former the 'bel' after the inventor of the telephone, and the latter the 'néper.' Feeling runs so high between the advocates of these two units that, faute de mieux, it has been decided to sanction the use of both.

The method of testing articulation is to send twenty-five different sounds to a recording observer slowly and uniformly. The percentage of the sounds received correctly measures the articulation. It is satisfactory to learn that with good, solid back microphones there is practically no ageing effect New microphones have to pass a comparative test against a standard. One of the tests of the new telephone receiver was to jar it by dropping it from a definite height on to a steel plate 100,000 times

This had little if any effect on its efficiency.

In the latter half of Mr. Cohen's paper he discusses the kind of apparatus most suitable as a telephone standard. He also discusses the frequency range for broadcasting, etc., recommended by the international committee. The 'ideal' range covers perfect reproduction of speech, music, and most noises. In this case all sounds having frequencies lying between 30 and 10,000 cycles per second must come through the apparatus. For 'high quality' speech and music, the necessary range includes all sounds having frequencies between 100 and 5000; whilst for 'good quality' articulate speech, only sounds having frequencies between 200 and 3000 are required. From the point of view of articulation, the mean speech frequency is 1500 cycles. This means that the removal of all the components of the sound which have frequencies above 1500 gives the same quality of articulation as the removal of all the frequencies below 1500 would give.

# The Mellon Institute.

TING developments of the work of the Institute in the University of Pittsburgh, i the last annual report, are the new s for analytical chemistry under Dr. and for 'pure chemistry' under Dr. L. H. When the Institute was originally estabquestion of the position of research in mistry and other subjects was considered. I contradict the director's statement that ire science investigator, who is the father fforts in industrial research, falls the glory those discoveries that lie at the groundour knowledge of nature, and of all our utilising natural products." But the uestion is whether 'pure' research should sed in another department of the Univerthe control of a director specially interested science, and, if so, what haison should een such department and the Institute, r an Institute primarily dedicated to research should make provision also for search. Apparently the original decision eversed, or perhaps it would be truer to ne development of the work of the Institute red necessary some provision for pure In a research institute of this magnitude, or advisory and consultative work both in chemistry and in pure chemistry can understood. ogress of the Institute is exhibited in the

report in the form of curves showing steady progress except for perturbations during the War period. The fellows, at present 102 in number, are at work in connexion with 58 industrial fellowships, and a sum of nearly £120,000 was paid during the last fiscal year in support of research in the Institute by the fellowship donors; and the total amount of money appropriated by companies and associations to the Institute during the first sixteen years of its work is approaching a million pounds, all of which was disbursed in sustaining fellowship research. These astonishing figures would have gratified the originator of the scheme, the late Prof. Duncan, and must give great satisfaction to the benefactor whose honoured name is associated with the Institute.

The Institute has published a bibliography of books, bulletins, journal contributions and patents issued from the Institute from the inauguration of the Industrial Fellowship system (March 1, 1911) to January 1, 1927. The director, Dr. E. R. Weidlein, expresses the hope that the list will serve a useful purpose, especially in libraries of other research laboratories. Incidentally, the publication gives convincing evidence of the success of the work initiated by Prof. Kennedy Duncan, of which particulars have been published from time to time in NATURE. The researches conducted in the Institute, with the financial support of industrial firms, cover a wide field in applied chemistry, physics, biology, metallurgy, and other subjects, and the long list of

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which is the contributing firms abatement, research on which has helped to clarify Pittsburgh's notorious atmosphere. A possible criticism of the list is that it would have been prefer-

able to restrict the entries to contribution interest to the exclusion of articles of a contribution of a contribution of a contribution of a contribution in the contribution of a contribution

# Insect Flagellates and Disease-A Study in Adaptation.1

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FLAGELLATES of the family Trypanosomide are for the most part parasites of the intestinal tract of invertebrates, chiefly insects. Infection is contaminative, one insect infecting itself from encysted stages of the flagellate voided in the faces of another. In African sleeping sickness the trypanosome lives both in the tse-tse fly and in man. It seems clear that originally these pathogenic flagellates were limited entirely to insect hosts, as the majority of the members

of the family still are.

It is found that certain lizards acquire an intestinal infection presumably by devouring infected insects. The flagellates finally adapt themselves to life in the lizard's intestine, whence in some cases they invade the blood stream. If the insect which causes the intestinal and blood infection when devoured by the lizard be one which sucks the blood, then such an insect might infect itself from the blood. The original contaminative method of infection of the insects from one another may still persist, though it may be no longer necessary. If it were lost a condition of affairs like that in Trypanosoma lewist would be reached. The flea ingests trypanosomes from the blood of the rat, and later voids trypanosomes in its fæces, which when eaten by the rat lead to infection. The infection is associated with development in the hind gut of the flea. In the case of sleeping sickness, trypanosomes taken up from the blood of man by the tse-tse fly develop in the anterior part of the alimentary tract and are inoculated into the skin when the fly feeds. Infection of man is inoculative and not con-

 $^1$  Substance of a paper read by Dr. C. M. Wenvon, C.M.G., C.B.E., F.R.S., to the Royal Society of Edinburgh on Qct. 21.

taminative as in the rat. The flagolla in the has moved from a posterior to an anter or station, else the tse-tse fly is not the original involvement for Surra of horses is transmitted by taballed flies i purely nechanical manner. The fly bites an fected animal, and if it feeds again within a faminutes on another animal, the trypanisomes who remain alive on or in its proboses are inventant. The chances of survival of the flagellar would agreater if it could establish itself in the flag a definite infection. It is possible that this has occurred in the state-tse fly; it would explain the development in the anterior part of the intestine. In his alternation oriental sore it has been shown that the parasite taken up by Phlebotomus develop in the anterior part of the intestine. Assuming that the said fly is the transmitter of these diseases, it has yet in he deferment how the flagellates are inoculated into human beings.

Flagellates have also adapted themsel es to life in plants. Studying such infections in Control America Strong has noted that plant bugs which hadron flagellates infect not only a Euphorbia but into a lizard which devours it. The inoculation of the flagellate from the lizard's intestine into the skin of a monkey caused an ulcer in which rounds that the flagellate persisted for more than two were the flagellate persisted for more than two were Though Strong's work undoubtedly required confirmation, it illustrates how insect flagellates originally confined entirely to the insect host, have adapted themselves to higher animals and plants and example in many cases led to the production of den

#### The Statistics of Accident Investigations.

AN important article has appeared in the Journal of the Royal Statistical Society (vol. 90, Part 3, 1927) on practical applications of the statistics of repeated events, particularly to industrial accidents, part of which had been read by Miss Newbold before the Society on April 26 last. Several times in these pages, articles dealing with accident investigations have been reviewed, and it is useful to have this very able summary of a number of separate lines of attack as well as the statistical details and tables. Research workers sometimes fail to understand some of the simpler laws of causation and reproduce their results in such a way as to render interpretation difficult or impossible. Averages are assumed without evidence to be what they seem to be, and comparisons are made between incomparable groups.

Miss Newbold's work shows the difficulties that confront the statistician when data have to be treated scientifically. She begins by a historical review of accident work and incidentally points out how complex are the problems involved. She considers the question first abstractly, looking upon an accident simply as an event, and assumes that we have a record of the numbers of such events happening to different people in certain periods of time and that the external conditions are uniform. Even with these assumptions, there arises the question as to whether the distribution of events among the individuals is a purely chance

one, and if it is not, to what extent are the underlying poculiarities masked by chance variations and how far we are able to strip off the mask and see the form of these peculiarities.

This involves a discussion of the mathematican treatment of such data and a consideration of after native methods. To know if a high accident of eater at a department is due to a few people of the entered conditions alike for all is of practical importance but is difficult to determine. On the whole, from a consideration of the work done so far, there come undication that the same people are likely to the curbon small and major accidents. Results, however are not sufficiently definite to provide a basis for infinite trative proposals, but the weight of the gradually accumulating evidence and the improvement in statistical technique show clearly that the work is

The discussion which followed the receiving of the, paper is also valuable, representing different pointer of view. Dr. M. Greenwood gave some distributions of the War the study of accidents be gradual development of the problem.

Wilson spoke about the improvement ir during recent years, so that no longer was to 'wait and see' in order to determine it was dangerous or not. He expressed the the time would come when we should be a

se who were lin ly to get accidents it them from entering certain occupa-Dr. Millais Culpin gave some actual examples a man's temperament expressed itself in ats and showed from his own researches that rent groups of people a considerable proportion ssed sympton s which would render them liable cidents should they be exposed to risk.

#### niversity and Educational Intelligence.

MBRIDGE.—The late Miss McArthur, formerly of in College, has left the residue of her estate, stated be not less than £4000, to the University for the ard of a prize or prizes for the encouragement of the dy of economic Listory

C. Rimington, Emmanuel College, has been re-Jected to the Benn W. Levy research studentship in

ochemistry.

The Financial Board has proposed to the University he purchase of the Balfour Laboratory from Newnham College, with the view of its being adapted to meet he needs of the Faculty of Geography.

Dr. R. Chodat has been appointed to represent the Juiversity at the celebration of the seventieth birthday of Prof. A. Pictet in Geneva, and Prof. Inglis for the coming centenary of the Institution of Civil

Ingineers.
The governing body of Emmanuel College offers to a research student, commencing residence at the University in October 1928, a studentship of the annual value of £150, tenable at Emmanuel College for two years, and renewable, in exceptional circumstances, for a third year. Preference will be given to a candidate who has already completed at least one but not more than two years of research studentship will be awarded in July, and applications should be sent so as to reach the Master of Emmanuel (The Master's Lodge, Emmanuel College, Cambridge, England) not later than June 30.

Edinburgh.—At the meeting of the University Court on Nov 14, it was announced that Lady Lyell of Kinnordy has presented to the Department of Geology valuable collections of minerals, rocks, and fossils, together with cabinets for keeping them. In addition, Lady Lyell has given many geological books, papers of historical interest, and a collection of autographed letters from scientific workers of note to the late Sir Charles Lyell.

London.—Messrs. J. Lyons and Co., Ltd., have contributed 250 guineas towards the establishment of

the proposed chair of dietetics.

Dr. J A. Braxton Hicks has been appointed as from Sept. I last to the University readership in pathology tenable at the Westminster Hospital Medical School. Dr. Hicks was educated at Epsom College (1896-1902) and Westminster Hospital Medical School. In 1907 he obtained the M.B., B.S. degrees with honours in athology, and in 1910 the M.D. degree in pathology of London and the D.P.H. (Cambridge). Since 1910 ne has worked in the Department of Pathology at the We +minster Hospital and Medical School, and since he aboratories were enlarged under the John Burford arlill Bequest, he has been director of the laboratories the Hospital and Medical School.

The King has approved the appointment of Prof. W. R. Halliday, professor of ancient history in the University of Liverpool, to be Principal of King's College, as from Jan. I next, in succession to Dr.

Ernest Barker, who has resigned.

OXFORD.—Profs. E. S. Goodrich and F. A. Lindenann have been appointed by the heads of the SCIEL

Library Auviso.
The Board of the ilty of Me... Mr. Arthur P. Dodds-Parker, of Magdalen

member of the committee for the control of the Lew-Evans Collection.

Prof. A. G. Tansley, Sherardian professor of botany, delivered his inaugural lecture on "The Future Development and Functions of the Oxford Department of Botany" on Nov 22.

The King has approved the appointment of Sir Edward Farquhar Buzzard to be Regius professor of medicine in the University, as from Jan 1 next, in succession to Sir Archibald Garrod, who has resigned.

ST. Andrews.—The University Court has appointed Mr D E Innes to be reader in geology in the University.

THE governors of Loughborough College invite applications for the award of five open scholarships in the Faculty of Engineering, each of the value of £75 per annum. The scholarships are open to British subjects from any part of the Empire, and are tenable at Loughborough College, Leics., England, for the period of the full diploma course. entrance examination for the session 1928-29 will be held on April 24, 25, and 26, 1928 All applicants must be not less than sixteen years of age on Oct. 1, Further particulars and application forms 1928 may be obtained from the College Registrar.

THE Council of the Royal Meteorological Society, with the view of encouraging the study of weather m schools, invites teachers to send in essays on that subject, for which three prizes will be given. The Council considers that the essay should include a description of the work which is actually being carried out or has been carried out by the teacher and his class The essays should be limited to 2000 words, but may be accompanied by examples of pupils' work. They should be received by the Society not later than June 30, 1928. It is hoped to publish the winning essay or essays in the Quarterly Journal of the Society. The essays should be forwarded to the Royal Meteorological Society, 49 Cromwell Road, London, S.W.7.

According to the statement for the year 1926-27 issued by the Rhodes Trust, there were 187 Rhodes Scholars in residence that year, of whom 93 were from the British Empire and 94 from the United States; 64 completed or gave up their scholarships. Of those in residence, 4 were taking mathematics, 32 natural science or medicine, and 2 forestry or agriculture. Sir Robert Borden, sometime Prime Minister of Canada, was the Rhodes Memorial Lecturer for the year and delivered three lectures on "Canada in the Commonwealth"; the lecturer for 1927-28 will be Dr. Abraham Flexner, of the Rockefeller General Education Board, New York. During the past year the Rev M R Ridley was appointed to the first Rhodes Travelling Fellowship; two further appointments, for which resident fellows, tutors, and lecturers at Oxford are eligible, will be made early in 1928. Information on the Rhodes Scholarships and Fellowships can be obtained from the offices of the Trust, Seymour House, Waterloo Place, London, S.W.1; in the United States, from President Aydelotte, Swarthmore College, Swarthmore, Pennsylvania; in Canada, from Mr. J. M Macdonnell, National Trust Company, Limited, Montreal, P.Q.; in Australia, from Dr. J. C. V. Behan, Trinity College, Parkville, Victoria; in South Africa, from Mr. P. T. Lewis, Court Chambers, Keerom Street, Cape Town.

No. 3030, Vol. 120]

, 1060.—The official record of the centy reads as follows "Memorandum that wovemb. 28, 1660, These persons following, according to the usuall custom of most of them, mett together at Gresham Colledge to heare Mr. Wren's lecture, viz. The Lord Brouncker, Mr. Boyle, Mr. Bruce, Sir Robert Moray, Sir Paul Neile, Dr. Wilkins, Dr. Goddard, Dr Petty, Mr. Ball, Mr. Rooke, Mr. Wren, Mr. Hill. And after the lecture was ended, they did according to the usual manner withdraw for mutual converse. .

November 28, 1867.—In a letter of this date, Gassiott told Tyndall the following story of Davy entering Pepys' shop in the Poultry. Showing him a letter Davy said, "Pepys, what am I to do, here is a letter from a young man named Faraday; he has been attending my lectures and wants me to give him employment at the Royal Institution—what am I to do?" "Do?" replied Popys, "put him to wash bottles; if he is good for anything he will do it directly, if he refuses he is good for nothing." no," replied Davy, "we must try him with something better than that." The sequel was that Faraday was employed to assist Davy in the laboratory.

November 30, 1845.—One of the most remarkable days in the history of railways was Nov. 30, 1845, the day fixed by the Board of Trade for lodging plans and specifications for new lines. Extraordinary measures were adopted for producing the documents and for getting them to London in time. No fewer than 1200 companies were started that year, the capital represented by the schemes amounting to £560,000,000. In 1846, 600 railway bills were actually brought forward, and it was then that 'the battle of the gauges' set in. It was, however, only on Brunel's gauges' set in. It was, however, only on Brunel' Great Western line that the 7-foot gauge was used.

December 2, 1846.—Some of the earliest experiments in arc lighting were made by Staite and Petrie, who worked together at various problems. To Petrie was due the invention of the first truly self-regulating are light, while on Nov. 28 and Dec. 2, 1846, he demonstrated the use of his light from the portico of

the National Gallery.

December 2, 1856.—On this day Friedrich and Wilhelm Siemens took out the British patent for their regenerative furnace, which a few years later found its most important application in the open hearth method of making mild steel by the Siemens Martin process—a process by which to-day more than 80 per

cent. of the steel of the world is produced.

December 2, 1857.—"The advantages of science in nautical affairs," said Mr. Fillmore, President of the United States, on Dec. 2, 1857, "have rarely been more strikingly illustrated than in the fact stated in the report of the Navy Department, that by means of the Wind and Current Charts projected and prepared by Lieutenant Maury, the Superintendent of the Naval Observatory, the passages from the Atlantic to the Pacific ports of our country have been shortened by about forty days." A writer three years later calculated that Maury's work saved the country more than 2,000,000 dollars per annum, and that a British sailing vessel on passage from England to Australia saved £1200 by the use of his charts.

December 3, 1847.—It was on Dec. 3, 1847, that Lyon Playfair wrote to James Young telling him of a petroleum spring in Reddings Colliery, Alfreton, Derbyshire, and suggesting he might turn it to account The flow of oil was only about 300 gallons a day and this rapidly diminished, but it was through this enterprise that Young was led to experiment on the distillation of oil from coal, and thus laid the foundation of the shale oil industry. E. C. S.

Societies and Acader is

LONDON.

Royal Society, Nov. 10 (continued for p. 5.31)

EXPER MENTAL PHYSIC

R. S Edwards On g effect of ter, continuous viscosity of air: New measurements or or french man on the variation with temperature the vire of air over the range of 15°C, to 444 the first accuracy of the results obtained by the A. Winner The present measurements corrob onto thos previous observers and not those of Wuliams. concluded that there is no breakdown of Sutherland law in the region of 250° C., and that Satherland constant is constant over the whole of the range me tioned above.

P. Kapitza: Further development of the methor of obtaining strong magnetic fields. These fields are obtained for a short period of time only, as it in the possible to apply large powers to the coil was not overheating it. In this manner fields of 100,000 muss, have been obtained. It is now possible to use to the powers. In the place of accumulators, large points. ator by means of which powers up to \$40,000 kilowata can be obtained in the coil for the sec. (18, been week.)
Up to the present, magnetic forces to a faith
350,000 gauss have been obtained in volume of 2 c.c.

F. H. Rolt and H. Barrell: Contact of that surf were. The object of this investigation was to applied into the phenomenon of 'wringing' which is used extensionly m forming combinations of gauge blocks of the Johansson type. These gauges, which are of hard and steel, have their important surfaces finished to a light degree of flatness, and when brought mio intimute contact are found to adhere together very strongly. The adherence depends to a large extent upon the smoothness of the surfaces; so much so, that gauges having optically polished surfaces can be made to adhere when quite clean, whereas the having and lapped' finish require the introduct. fine film of oil or other liquid to prod a concelle Repeated wringing together of gauges to a shift but measurable wear of their surfaces the discourse is explained as the molecular attraction become the surface molecules of the gauges In the analysis surfaces, the average separation between the stateand the abuse cules on the two surfaces is considerably with smooth surfaces, and the function and the surfaces in the former case is to act as a link bety

widely separated molecules.

W. Mandell: The determination c moduli of the piezo-electric crystal Ro-electric properties, the magnitude of the offeet hering several hundred times greater than with effect is associated only with crysta. asymmetric structure, and occurs when submitted to mechanical stresses. It we appear that the phenomenon may be c to its elastic properties Elastic surfaces giving a numerical measure of the exter not per unit length for unit tension for all directions in the crystal whilst other surfaces give the amount consion profile unit couple. Rochelle salt almost los electric properties in a very abrupt mani ron reisin the temperature above 23° C. The e measured by the 'bending-beam' meth at for tour peratures above and below this critical particles and change in elasticity due to molecular re was too small to be measured by this me electric crystals exhibit a change in doubt

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inostatic stress. Pockels to determine whether thus an way due solely to the suspet by the electric field or are of influence of the electrostion in these crystals. On the electrostion in the electrospital formula, the electrospital rostatic field is about five times at an electrospital to Rochelle salt agrees with dance of distinction, namely, that an are sever a direct influence in piezo-

: In tigation of the molecular maxic optically active crystals. 15: 11: rhodium oxalate, sodium at or'er mamme sulphate, guandine ... enther ally umaxial or so nearly so derrace a nappreciable Their optical the ascend to a special atomic arrangecertain in of structure The similarity the rotatory of spersion curves of crystals and w. of derect re rum rhodium oxalate is not due rence of the allel molecules in the crystalline he mothers are spirally arranged in the Potassian bithium sulphate is an exceptional of a controlly active crystal In this case special culty in making sure about the ce or a' are of a lamellar structure

E. Waisan the dielectric constants of ammonia, dune and · ine: The dielectric constants were uned 51 54 peratures near to -47°, 16° and nequencies of approximately 300, C. med Pand tree A heterodyne method was used. ndependent of the frequency within erimental error. The quantity  $\epsilon-1$ e results o ie liant e o the density, although there is some a. Progongs to the compressibility correction. , the read the variation of e with temperature proximately by Debye's equation, and ues for the electric moments of the are sent in the till it inoleant Is allated by it are  $1.49 \times 10^{-18}$  for ammonia, 1.55 r phosphine, and  $0.15 \times 10^{-18}$  or possibly lim 3.

tchison and C N Hinshelwood The bility of nitrous oxide and ammonia in discharge In discharge tubes at low mmonia is five to seven times as stable oxide. Since this ratio remains of the same in different electrode materials are used, the discharge is passed through the two ier in series or in parallel, it is probably to conclude that ammonia requires ionic of considerably more violence to decompose those required by nitrous oxide.

McLennan, R Ruedy, and E. Cohen: The ac susceptibility of the alkali metals. Sodium, um, rubidium and casium are paramagnetic of diamagnetic.

F. Elam: Tensile tests on alloy crystals (4).

runents have been made on the distortion of als of a copper alloy containing 5 per cent. unium. Like the brass crystals already investigated, these slip for a longer period on one octahedral ne than would be expected from geometrical concertions. A cored structure does not appear to ect the slip-plane and the direction of slip, but the annealed crystal is harder than the un-annealed. In the early stages of deformation copper is harder,

In the early stages of deformation copper is harder, and hardens more rapidly for the same amount of shear than either of the alloys, but both the final breaking load and the elongation are higher in the case of the alloys.

D. W. Dye . A magnetometer to of the earth's vertical magnetic in measure The instrument consists coil system set up with its axis truly ver. the appropriate current traverses the coil rot the appropriate current traverses the coil, John's the vertical component of the earth's field is sactly neutralised The resultant field is horizontal and directed along the magnetic meridian This condition is indicated by the help of a small vibration detector The detector consists of a small and very light flat coil free to vibrate about a horizontal axis normally lying approximately in the plane of the magnetic meridian. The plane of the coil is vertical and the axis of vibration horizontal. The coil is traversed by a relatively large alternating current at its resonant vibration frequency these conditions it is very sensitive to a vertical The condition of rest of the coil corresponds to a zero vertical field. The sensitivity is equivalent to about ly The complete installation enables a measure of vertical intensity in C ( S. units to be realised to an absolute accuracy of about  $2\gamma$ . Baseline values should be realisable to a reproducibility

G W C Kaye and W F. Higgins. The thermal conductivities of certain liquids. The thermal conductivities of a number of common liquids have been determined by a 'plate' method, over a range of temperatures up to 200° C. The test layers had an area of about 20 sq. cm and thicknesses up to 0 5 mm. The following table summarises the chief results

Liquid	Conductivity at 20° C	Temp, coeff a.
Water	0 00149	$+0.001_{2}$
Glycerine .	$0.00068_{0}$	$+0.0005_3$
Castor oil .	0.00043	$-0.0005_0$
Anılıne .	$0.00041_{2}^{-}$	0.0000
Olive oil	0 000402	$-0.0003_{2}$
Cylinder oil.	$0.00036_{6}^{-}$	$-0.0004_{1}$
Transformer oil .	$0.00032_{1}$	$-0.0006_{2}$
Medicinal paraffin	$0.00030_0^{-}$	$-0.0000^{-1}$
Paraffin oil · .	$0.00029_8$	$-0.0005^{2}$

#### THEORETICAL PHYSICS.

H. Levy and A. G. Forsdyke. The vibrations of an infinite system of vortex rings. In a previous paper the stability was examined of an infinite system of equal vortex rings situated in parallel planes with their centres evenly spaced along an infinite line and with their planes at right angles to that line. Instability was found to occur for disturbances confined to displacements of the centre of each ring along the central axis, the filament of each ring still remaining circular. The investigation is now extended to deformation of the vortex filaments. Conclusions are drawn regarding natural modes of vibration of the system; it is found, for example, that for any given ratio of radius of ring section to radius of ring there exists a critical ratio of ring spacing to radius, separating the region of stable oscillation from that of instability.

L. Rosenhead: Resistance to a barrier in the shape of an arc of a circle. The method is based upon the transformation introduced by Levi-Cività in 1906, and the approximation process used by Brodetsky. The value of the thrust and its line of action are obtained for barriers of both concave and convex camber, and for various angles of incidence. From these figures curves are plotted, from which the thrust for any particular camber and any possible angle of incidence can be obtained by interpolation. The results are interesting for the following reasons: (a) As the angle of incidence decreases, the centre of pressure, in the case of small concave cambers, moves

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aches a maximum forward position, , 1060 tekwards This is more marked the sourcety reads per (b) The effect of camber on thath 28, 1660 thrust is much more marked with small angle of incidence than with large angle of

incidence

C. V. Raman and K. S. Krishnan: A theory of electric and magnetic birefringence in liquids. local polarisation field acting on any molecule must depend on its orientation. The Langevin-Born theory is accordingly modified so as to take this 'anisotropy of the polarisation field also into account and the modified expression for birefringence is in better accord with facts. As a rule the effect of the 'anisotropy' of the polarisation field is to diminish the magnitude of the birefringence to be expected, due to the fact that, in general, the longer linear dimension of a molecule tends to be also the direction of maximum electrical and optical susceptibility. The distribution of the molecules in a dense fluid therefore tends to be such that their mutual influence is equivalent to an apparent diminution in the anisotropy of the mole-

E. T. Whittaker: On electric phenomena in gravitational fields. It is a consequence of general relativity that when electromagnetic phenomena of any kind take place in a gravitational field, they are influenced by the field; that is to say, the Maxwell's equations of the electromagnetic phenomenon must be replaced by other equations which involve the gravitational curvature of space Two kinds of gravitational field are here considered, namely · (1) the field due to a single attracting mass and (2) a limiting case of this, which is called a quasi-uniform field: within these gravitational fields, electromagnetic phenomena are supposed to take place. The mathematical solutions of a number of problems correspond to well-known solutions in the classical Maxwellian theory. The results of the investigation are for the most part expressible only in terms of Bessel functions and of certain new functions which are introduced: but in some interesting cases the electromagnetic phenomena can be represented in terms of elementary functions, as for example the electric field due to an electron in a quasi-uniform gravitational field, and the spherical electromagnetic waves of short wave-length about a gravitating mass.

W. R. C. Coode-Adams: The refractive index of quartz. The characteristic frequencies in dispersion formulæ can now be obtained from the formula for optical rotation and applied to an equation of the Ketteler-Helmholtz type.

Physical Society, Oct. 28.—W. N. Bond The theory of liquid flow through cones. An approximate general solution is given of the hydro-dynamical equations for liquid flow through conical tubes of circular section, the errors due to the approximation being small for converging cones of small angle and for flow through similar diverging cones up to the speed at which the theory predicts turbulent motion.—H. P. Walmsley: The structure of the smoke particles from a cadmium arc. Using the powder method of X-ray analysis, the particles dispersed in air from a cadmium arc are found to be isometric crystals of cadmium oxide. From X-ray data, a density of 8.16 was obtained for the primary particles in the smokes—the normal density of cadmium oxide. Photometric measurements of the breadth of the lines showed that the primary crystals were of colloidal dimensions, values of  $5.8 \times 10^{-6}$  cm and  $4.9 \times 10^{-6}$  cm. being obtained in two cases. aggregation, the ultramicroscopic crystals grow along binary axes of symmetry, ie. they tend to unite on their 110 faces.

PARI

Academy of Sciences, announced the death of Si E. I. Fredholm, corresponda E. Goursat. A problem of gourdan: A means of improv of time -- Camille Matignon Marchal: The action of calci aluminium on beryllia. On he beryllia and metallic calcium in a the beryllia is partially reduced, cent. of the theoretical proportial found. Substituting magnesium to beryllium is still produced but in sin With aluminium the reduction is Douvillé. The Cretaceous in the Bry breccias and conglomerates. -- Léon addition of nitrogen to special steets. I results on the effects of heating in ammonia chromium steels and nickel-chromium steels, with special reference to the change ness and elastic properties. The bratteduced in certain steels by this treatment, i 'Krupp's disease,' can be ameliorated by the of molybdenum in small proportions. Margerie · Report on the state of publication "Œuvres géologiques de Marcel Bertrana Bigot · Monasterian and post-Monasterian for a of Basse Normandie. D. Mirimanoit and R. L Repeated trials and the formula of Lapla Widder and Gergen: A generalisation of a theore Mandelbrojt.—Georges Valiron: The coefficient the usual Taylor's series.—W. Sierpinski: Se properties of projective ensembles.- N. Lusin: marks on projective ensembles.—Enule Borel: 1 marks on the notes of Sierpinski and Lusin-Grialou: Weir with a thin wall; calculation of the yield —D. Riabouchinsky: A problem of variation. Elie Carafoli: A general method for drawing aviation profiles.—Pierre Vernotte and Marcel Allegrin: The measurement of the the rad conductor y of metals. The method of the pomes stationary imperature A modification of the method of reddrauselt. Pierre Bricout: Quantitative study or the lumi escence of mercury vapour excited by electron bombardment. Measurements were man of intensity of the radiation λ2536 where the energy. the exciting electrons was varied from " to 18th vo , Starting with simple hypotheses, an expression deduced for the law of resonance of the monitories, atom. This is shown to be in good . General \*\* the experimental data—G. P. Arcay and W Remarks on the determination of the coefficient magnetisation of certain liquids. Using the of Sève two classes of liquid were observe group, including collodion, glycerol, castor of other oils, under the influence of the magnet (12,000 to 13,000 gauss) the new level was \$ assumed and remained fixed; the other general solutions of gelatine, gum arabic, casem, and golatmous silica, presented an an the first rapid change of level being followed by slow change, due to a slow mercase in the magnetisation coefficient. This effect is probably due o the rigidity of the liquids.—Salomon Rosenbluin: The slowing down of the a-rays by matter.—Pierre Jolibois and Henri Lefebvre: A new reaction of active nitrogen. Carbon monoxide under low pressure is slightly decomposed by strong sparks. The rate of production of carbon dioxide is increased seven times if the gas is diluted with pure nitrogen. The authors explain the phenomenon by assuming a catalytic action of active nitrogen in the course of reversion

normal nitrogen -P. Lasareff and V. Lazarev: he absorption spectra of borax glass coloured with coper salts The borax glass was examined in two c.ms, one suddenly and the other gradually cooled. Fire absorption spectra were identical, but differed ..om that given by copper sulphate in solution is concluded that the coloration of the borax glass is not due to corper ions, but is produced by complex compounds of copper and borax -C Grard and J. Villey. The thermal conductivity of the light alloys. Magnesium win 4 per cent of copper has both mechanical and thermal characteristics superior to those alloys of aluminium and copper commonly employed.-Albert Roux · The control of welds by the magnetic spectra.—Brutzkus. The calculation of gas analyses. In many technical reactions a certain gas mixture, submitted to a chemical treatment, is analysed before and after the treatment. For the interpretation of the results it is necessary to determine the quantities of gas which have disappeared in the course of the treatment without knowing the total quantity solution of this problem is given.—B Bogitch: Some improvements in the electrical fusion of poor minerals. A description of a modification of the type of electric furnace employed.—J. Thoulet A double circulation of the ocean, deep and superficial.-Marcel Mascré: The fixation of the chondriome of the plant cell. A comparative study of the effects of various fixing liquids containing formol with acetic, cyanacetic, monochloracetic, or trichloracetic acid. It is shown that the acidity (pH) is not the only factor.—R. Herpin: A case of incubation by the female in Leptonereis glauca which swarms on the surface -Pierre P. Ravault: Histochemical researches on the distribution of lime in the wall of the normal human aorta - Mme Andrée Roche and Jean Roche. Researches on the existence of the lactacidogen in the blood.—Mme. Anna Drzewina and Georges Bohn: The influence of the walls of vessels on the reactions of animals.-Edouard Chatton and André Lwoff: The evolutive cycle & Synophrya hypertrophica (ciliated Fættingeriidæ..

. VIENNA. Academy of Sciences, July 14.-R. Weiss and G. chlesinger: Action of organic magnesium compounds 1 : o-phthalonitril .-- A Muller and A. Sauerwald : New or thesis of 1, 6-dibrom-n-hexane and its action on pluol-sulphamide -A. Kailan and A. Blumenstock rate of saponification of stearo-lactone with relic alkalı solution.—A. Kailan and L. Olbrich. 0 } ana cidation of hydrocarbons by air. Experiments gar / h paraffin and naphthalene at 183° and jus 99° 4, passing the oxygen through these mpa various rates and for varying lengths and without catalysers Thus when t the ir was passed through 100 grams of potassiv to 0 hours, 8 per cent. of the residuum mto saponifiable constituents—W. J.

C. F. T. anodic behaviour and passivity of C. F ExperitA. Fohler: Ore-containing rocks of the 14 Marian forest quarter. Exposures were ar Marbach and elsewhere in the Danube unical analyses are given of quartzriyry, mica - diorite - porphyrite, horn-porphyrite.—M. Blau: Radium Instiication, No. 208. The photographic ays.—B. Karlık: Radium Institute The dependence of No. 209. the nature of the zine sulphide and of the semtillation process.—W. thermo-plummet (Warme-lot), an ording the temperatures of depths No

#### Official Publications Received.

#### BRITISH

BRITISH

Transvaal University College, Pretoria Bulletin No 12 1 and Famming in the Transvaal, Part 1 A Preliminary Investing to the Variability of the Rainfall of the Transvaal, by Prof Plummer, Part 1. Rainfall in relation to Agriculture in the Tra by Prof H D Leppan Pp. 63+17 maps. (Pretoria).

The Quarterly Journal of the Geological Society Vol S3, 1 No 331, October 20th Pp 345-550+plates 24-42 (London Long Green and Co., Ltd.) 7s. vd.

Aeronautical Research Committee Reports and Memoranda 1098 (Ae 277) The Distribution of Pressure over a Monoplane Biplane with Wings of Unequal Chord and Equal Span By Batson, A S Halliday and A L Madens. (A 31 Pressure Dition, 14—T. 2406) Pp 28+13 plates 1s. 3d. net. No. 1100 (Ac Wind Funnel Experiments on the Effect on the Maximum Lift of drawing and Discharging An from the Upper Surface of an Aerofool drawing and Discharging Au from the Upper Surface of an Aerofoil W G A Perring and Dr G P Douglas. (A 3 a Aerofoils Genera — T 2470) Pp 5+7 plates. od. net (London H M Stati

Office Biological Reviews and Biological Proceedings of the Camb Philosophical Society Edited by H Munio Fox Vol 2, N October Pp 285-396+vii (Cambridge At the University P

University of Cambridge. Solar Physics Observatory Fourt Annual Report of the Director of the Solar Physics Observato the Solar Physics Committee, 1926 April 1—1927 March 31. F

(Cambridge)

Proceedings of the London Mathematical Society Second St Vol 26 Pp n+658. (London Francis Hodgson)

The Dioptric Bulletin Edited by John H Sutchiffe Vol. 29, N September The Transactions of the British Optical Association. 345-645 (London British Optical Association)

Bulletin of the Madras Government Museum. New Series, Natur. History Section, Vol. 1, No. 1. The Littoral Fauna of Krusadai 'slar in the Gulf of Manar; with Appendices on the Vertebrates and 2-lan By various Authors Pp. v+190+20 plates (Madras: Governme Press.) 8 rupees. New Series, Natura

#### FOREIGN.

Report of the Oceanographical Investigation No. 2. Report of to Current Observations The First Report, Results of the Current Measuments in the Adjacent Seas of Tyosen, 1923-1926. Pp. 1v+98+32+50 11+20 plates. (Fusan, Chosen Government Fishery Experiment 11+20 plates. Station)

Guirent Observations The First Report, Results of the Current Measu ments in the Adjacent Seas of Tyosen, 1023-1026, Pp. 14-68-824-50 in+20 plates. (Fusan, Chosen Government Fishery Experimen Station)

Scientific Papers of the Institute of Physical and Chemical Resea No. 70. Effect of Combined Fat and Vitamin A Deticiency on Gro and Organ Weight of Albimo Rats. By Waro Nakahana and Tas Yokoyama. Pp. 03-78. 15 sen. Nos. 71-72 The Crystal System a-Thallium, by Genshichi Asahara and Toshiwo Sasahara. The Cry Stuicture of a Thallium, by Toshiwo Sasahara. Pp. 70-104+plates 1 40 sen. No. 73: Studo pri Magneziokshklorida Cemento per X-R De Tutomu Maeda. Pp. 95-102 20 sen. No. 74 On the Nutritive of Fats and Lipods. By Katsumi Takahash. Pp. 102-132. 50 Nos. 75-70. La Akva Vaporpremo de Magnezioksiklorida Cemento, Stato de Akvo en Ghi, de Tutomu Maeda; La Malhioligho de Magniklorida Cemento, kaj la Funkcio de Libera Akvo, Kristalda Adsorbita Akvo, de Tutomu Maeda. Pp. 138-164. 40 sen. No the State of the Mosture adsorbed on Acid Barth. By Hajime Pp. 155-190+plates 18-20. 00 sen. No. 78. On the Diovyquinoline obtained from Acid of Rolin-77 normineuritis of Pigeon. By Yoshikazu Sahashi. Pp. 1917. On the Anomalous Dispersion and Alsonption of By Sau-ichiro Mizushima. Pp. 201-248 60 sen. No. 80-activity of the Rubidum extracted from the Lepidolite and of Japan, by Satoyasu limori and Jun Yoshimuua, Lep. Nagaton; Chikuren Province, and the Lithium Content of Jap by Satoyasu limori and Jun Yoshimuua; Alkali Metals in Ishikawa, Ivaki Province, by Jun Yoshimuua; Alkali Metals in Ishikawa, Ivaki Province, by Jun Yoshimuua; Alkali Metals in 1 Ishikawa, Ivaki Province, by Jun Yoshimuua; Alkali Metals in 1 Ishikawa, Ivaki Province, by Jun Yoshimua; Susaki. Pp. 20-sen. No. 84 New Method for Measuring the Cutting Force of and some Experimental Results. By Masatosi Okochi and Ma. Okoshi Pp. 201-302+plates 21-26 1.50 yen. (Tokyo Iwanami Shoti Department of the Interior Buicau of Education Bulletin, 192. No. 24 Rural School Supervision.

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### Diary of Societies.

SATURDAY, NOVEMBER 26

of England Institute of Mining and Mechanical Engineers crates and Students' Section) (at Newcastle upon-Tyne), at 3—20x Modern Surveying Institutents (Lecture),—The following is will be open for further discussion—Feeding and Treatment amals Below Ground and Stabling, by W S Ruder, Remarks on Mines (Working Facilities and Support) Act, 1923, by J S.

Institution of Great Britain, at 3 -G Holst Samuel Wesley Robert Pearsall (II)

THE OF BRITISH FOUNDRYMEN (East Mullands Branch) (at Technical ge, Derby), at 6 - J E Fletcher The Control of Hardness, ess., and Soundness in Grey Iron Castings

UPL OF BRITISH FOUNDRYMEN (New castle and District Branch) (at

ille Hall, Newcastle on-Tyne), at o 15 -W West. Oil Sand for or Cylinders

#### MONDAY, NOVEMBER 28

L Society of Arts (Dominions and Colonies Section), at 430—E the Spanish Ambassadur A Short Explanatory Lecture on a m showing the Visit of the King and Queen of Spain to the bala and Rifl Country of Morocco—At 8—Prof H C II. penter Alloy Steels, their Manufacture, Properties, and Uses nto Lectures) (III)
Tutte of Actuarity, at 5.—H E Raynes The Place of Ordinary icks and Shares (as distinct from fixed Interest bearing Securities) the Investments of Life Funds
Tuttion of Electrical Exchanges (North Eastern Centre) (ci.

Trution of Electrical Engineers (North-Eastein Centre) (at mstrong College, Newcastle upon Tyne), at 7—B S Cohen paratus Standards of Telephonic Transmission, and the Technique Testing Microphones and Receivers.

SITUTION OF AUTOMOBILE ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7 30—Capt C H. Kuhne Military Transport Vehicles—Recent Development and their Commercial

DYAL DOTTOY OF MEDICINE (Oliontology Section), at 8 —B Underwood Case of Pain and Swelling in Submavillary Gland caused by Pressure of Denture.—I. S. Spain. The Uses of Nitrous Oxide and Oxygen in Dentistry.

PARL AFRONAUTICAL SOCIETY (Leeds Branch)—Plot. B. M. Jones: The Control of Stalled Aeroplanes

RDICAL SOCIETY OF LONDON—T P. Legg and others. Discussion on the Society's Report on the late Results of Operation for Carcinoma of the Peace.

#### TUESDAY, NOVLMBER 29

AL INSTITUTION OF GREAT BRITAIN, at 5.15 - Sir William H. Bragg Year's Work in X-Ray-Crystal Analysis (II) "ITTUTION OF CIVIL BROINERS, at 6.—G. L. Watson. The Design and onstruction of the Sewage-Treatment Works of the City of Trenton, and Letter U.S.

oustruction of the Sewage-Treatment works of the City of Trenton, 3w Jersey, U S A 1TUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at geneers Club, Manchester), at 7 — A. If Law and J P Cinthenden: gher Steam Pressures and their Application to the Steam Turbine. futr. of Metallugical Society and Staffordshire Iron and Steel Institute) Engineers' Club, Birmingham), at 7.—Dr. G D. Bengough osson.

Protographic Society of Great Britain, at 7.—Dr C V.
Wave Theory and Measurement of Lens Aberrations
merial Lecture).

LLECTRICAL ENGINEERS (North Mudland Centre) (at pole, Leeds), at 715.—Informal Discussions on Oil-constite Control of a Hydro-Extractor, J V. Levett and 1 The Contractor's Place in the Industry, H. Moss and

ST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS strongh Branch) (at Cleveland Scientific and Technical Institutional debrough) at 7.30.—W. C Freeman The Production and ern Application of Dissolved Acetylene

L ANTEROPOLOGICAL INSTITUTE, at 830 -Y. K. Snommen. The atest Pictures of the Finnish People.

#### WEDNESDAY, NOVEMBER 30

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4-Prof. Blair Bell: The Prevention of Cancer.

ROYAL SOCIETY, at 4 — Anniversary Meeting
GEOLOGICAL SOCIETY OF LONDON, at 5 80 — C W. Osman The Granites
of the Scilly Isles, and their Relation to the Dartmoon Granites
ELECTRICAL ASSOCIATION FOR WOMEN (at E L M A Lighting Service
Bureau, 15 Savoy Street), at 7 — Miss M Partridge Simple Housebold Renairs. hold Repairs.

HOLDERS (South Midland Centre) (at Birmingham University), at 7-P R. Coursey and H. Andrewes

Battery-Eliminators

North-East Coast Institution of Engineers and Shipbuilders
(Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7 15.—

B. Reed 'Boiler Performance

B. Reed 'Boiler Performance LASHOW UNIVERSITY ALCHEMISTS' CLUB (jointly with Glasgow University Geological Society) (in Glasgow University), at 730—Prof 'G. H. Boswell . Reflactories at Society of Arrs, at 8—Prof II E. Armstrong: Marcellin clot and Synthetic Chemistry

1817

THURSDAY, DECEMBER 1. M A Lighting Service Innian Society of London, at 5 Miss D Aube Robson Discussion Are the Mollusca a Monophylet Hopwood Exhibition of Vertebrate Remains from

Hopwood Exhibition of Verentiate Remains from Kenya Colony
ROYAL Institution of Great Britain, at a 1.— Dr. R. London before the Norman Conquest (III.).
INSTITUTION OF ELECTRICAL ENGINEERS, at 6 - R. Electric Ploughing.
ROYAL ARRONAUTICAL SOCIETY, at 6 30.— Major J. D. R.

ROLLIA ARRONAUTICAL SOCIETY, at 6-30.— Major J D R lem of the Long Range Flying Boat
OTHEMICAL SOCIETY, at 8.— D. T. A. Henry and H. Beckmann's Chromic Acid Mixture on some Monor R. Grindley and Dr. F. L. Pyman: The Condensation with Formaldelyde.—W. Hubball and Dr. F. L. Py 1(7) formaldelyde.—G. F. Smith and Prof. T. M. of Dynamic Isomerism Part XXVI. Consecutive Mutarotation of Galactose.—O. L. Brady and C. V. R. Compounds. Part II. Methylation of some I benzotiazoles—D. R. Boyd and D. B. Ladhambetween Diaryloxy-isophopyl Alcohols and Phosphot the Presence of Pyridine
INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Brai

· Villan INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Brai II Bragg: Application of X-rays to the Study of Structure of Materials (Thomas Hawksley Lecture).

#### FRIDAY, DECEMBER 2

Some resistance, and a new medical of estationary of Chemical Industry (Manchester Section antly with Fuel Section) (at Engineers' Club, Manchester), 1. Dr. J. A. Bowie, Coal and Co-partnership Royal Photographic Society of Great Britain formal Meeting), at 7—A. II. Blake: The Pictor of Appet of Old Buildings.

INSTITUTION OF ENGINEERS (Informal Marriag), at 4, '0,

Questions and Discussions.

Geologists' Association (at University College), at the Or. 18. W Wooldridge. The 200 foot Platform in the London Book. Or. A.B. Wells and Dr. S. W. Wooldridge. On the Rock Gran, that I viscy with special reference to Intrusive Phenomena at Rone.

Puttorogical Society (at University College), at \$100. Vocadia.

Purism.
Oxford University Junior Scientific Club. J. . Antomath a

Telephones

SATURDAY, DECLMBER 3

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 Wesley and Robert Pearsall (III).

INSTITUTE OF CHEMISTRY (Manchester and Districthester) —Address by Chairman. - 0, 'at Mun

#### PUBLIC LECTURES.

SATURDAY, NOVEMBER 26.

HORNIMAN MUSEUM (Forest Hill), at 3 30 - J E. . tail : Nut

in the Alps. MONDAY, NOVEMBER 28

University of Liebs, at 5.15.—Prof B M. Jones: The Dynai the Lifting Wing,
EASP Anglian Institute of Agriculture (Chelmsford).

Bond . Soil Cultivation.

TUESDAY, NOVEMBER 29.

NIVERSITY OF BRISTOL (Physiological Theatre), a Devine: The Reality of Delusions (Long Fox Memorial. University

WEDNESDAY, NOVEMBER 30

King's College, at 5.30—H Ward The Training College University College, at 5.30.—H Jenkinson Seals Modern

LONDON SCHOOL OF ECONOMICS, at 6. J. J. Walsh . ( Management Statistics.

THURSDAY, DECEMBER 1.

LONDON SCHOOL OF ECONOMICS, at 5 -Prof. L Theory and the Social Problem. (Succeeding Lect

SATURDAY, DECEMBER 3.

HORNIMAN MUSEUM (Forest Hill), at 3 30 .- C Dai

#### CONGRESSES.

DECEMBER 7 AND SUCCEEDING DAT

FIFTH PAN-AMERICAN CHILD CONGRESS (at Havrin

DECEMBER 13 TO 16



### SATURDAY, DECEMBER 3, 1927.

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### Nationalism and Research.

MONG the many developments of recent disturbed conditions in China, there is one which has passed almost unnoticed, but nevertheless is of such moment to the world movement in science as to merit more than a cursory reference. This is the attitude which has been adopted by a section of educated Chinese towards the prosecution of certain branches of scientific research within the borders of China by non-Chinese workers. Objection has been taken to the exploitation, as it is regarded, of the relics of China's past by expeditions coming from Europe and America

In the spring of this year an article was circulated to the Chinese press by Kuo Wen, in which a joint statement was made on behalf of several Chinese scientific organisations in Peking, announcing the formation of a United Association to fight the efforts of various scientific expeditions to search for the remains of ancient man and other evidence of a palæontological and archæological character in various parts of China This manifesto had special reference to Dr. Sven Hedin's journey into the desert region of western China, but it was also undoubtedly aimed at the expedition of the American Museum of Natural History to Central Asia. It at any rate moved Mr. Roy Chapman Andrews, the leader of the American expedition, to a vigorous and lengthy reply in the North China Daily News in July last, in which he stressed the indebtedness of Chma itself as well as the world of science at large to this and similar expeditions for scientific research Since then it has been decreed that no specimens of birds may be exported from China, and only three scientific specimens of any other species of animal reference facilities in China, this decree will obviously greatly hamper identification and research. The later barring of Mongolia to the American expedition is ostensibly attributed to military and political reasons.

That the extent of China's indebtedness to western science is great is a matter which is beyond question. Nor would it be denied by many of the Chinese themselves. In the present instance the protest which is raised on an issue in relation to certain specific material, even though the motives underlying it are undoubtedly mixed, may be taken at its face value as representing a genuine opinion of a certain section, at least, of educated Chinese, and not solely as a reactionary reflex of a

conservatism which abhors all foreign intervention of any kind whatsoever It is rather the manifestation of an exaggerated, and perhaps it might be thought perverted, nationalism This attitude is by no means confined to China, it can be paralleled at the present day in other countries, and it has given rise to problems of considerable magnitude in the prosecution of scientific research in countries rich in remains of the past, in which a strong movement towards nationalism has led the more ardent spirits to desire the exclusion of foreigners from such studies, although the natives themselves are not always fully competent to undertake them. In Egypt this feeling was given emphatic expression at the time of the opening of the tomb of Tutankhamen, and it is the essence of the spirit in which concessions, much more strictly limited than in the past, are now granted to foreigners. In India the difference in conditions has for the moment obscured the result, though the problem affects a wider scientific field; but the substitution of Indians for Europeans in official posts of organisation and research cannot but affect such studies until parity of intellectual qualifications has been attained. In both cases a political theory is adversely affecting the vigorous and effective prosecution of research

Granting for the moment that nationalism were a possible or even desirable ideal in the prosecution of research, it must be abundantly clear that in countries which are only just beginning to advance along western lines of development, undue restriction of exploration and excavation defeats the very object in view. It closes the best avenue to scientific training open to the native student

In both Egypt and India, interest m historical and archæological matters is no recent growth, yet it is the application of methods of research developed in Europe by European scholars which has been so fruitful in results. China is an even more striking example of the advance in knowledge of the past which has been effected by foreigners. The interests of the Chinese themselves being turned in other directions, they had neither the inclination nor the technical training to look for and appreciate the importance of the evidence which lay under their feet until attention had been directed to it by the work of alien investigators

Of purely geographical exploration it is scarcely necessary to speak in this connexion, while the borderland researches of A. von le Coq, of Dr. Sven Hedin in Tibet, of Sir Aurel Stein in Chinese Turkestan, and of Koslov in Mongolia, are too well known to need more than passing mention. All

alike have played an important part in opening up China and the adjacent lands to the knowledge of the western world, have revealed their great stores of archæological riches, and have helped to attract the attention of scientific workers to Central and Eastern Asia as a fruitful and profitable field of Nor is it necessary to do more than refer research to the recent work of Shirokogoroff on the physical anthropology and culture of China. But China hasnow assumed a position of significance in palæontological and anthropological studies in a broader sense, and granted the continuation of exploration. may contribute evidence of the greatest importance for the problem of the origin of man and the de velopment and distribution of his early culture The sensational discovery of the eggs of the dinosaur by the expedition of the American Museum of Natural History has overshadowed the less striking but perhaps no less valuable archæological data collected by that expedition which related to early man m the stone age and the early ages of metal  $ilde{ ilde{1}}$ this area. Equally valuable and stimulating hav been the researches of P Licent and P Teilhard du Chardin, whose investigations have brought to light stone implements of types analogous to those of the Palæolithic age in western Europe in conditions which apparently place it beyond question that the geological evidence assures the quaternary date

The discovery of evidence for quaternary man \* China is of first-rate importance, but its interest has since been greatly enhanced by the discovery of teeth, claimed to be human or sub-human, a Chou Kou Tien, and estimated to be contemporar with Piltdown man. This in turn would le' support to the human origin attributed to fossi. teeth of primitive type bought in Peking some years ago. Coming to a later period, a discovery of the greatest interest arose from the excavation of sites of neolithic culture in Honan and Fengtien on which there occurred painted pottery similar is technique and decoration to that which has been found in the early archæological strata of Western Asia, Mesopotamia, Anau, Susa, and other sites. Although the question of dating still remains open this discovery links up with a series of sporadi finds stretching across Asia and appears to brii China into some sort of relationship, still to ' defined, with the west at an early date

These results have been achieved through th labours of non-Chinese men of science, and withouthe active co-operation of the Chinese themselve although those who have been responsible for a results acknowledge that in most part they have

ceived full and courteous consideration at their hands. But many difficulties have been encountered. This must be taken neither as a criticism nor an attribution of blame. The difficulties were in part financial, in part due to a failure to appreciate the opportunities for research in this field, even when pointed out. That China now assumes a place of importance in the study of early prehistory is due almost entirely to Dr. J. C. Andersson, the Swedish investigator, who acts as mining adviser to the Chinese Government. By his own work, in directing and inspiring the work of others, and by raising funds for publication, he has made prehistoric China known to the world.

There is an interesting parallel in the occasion for the protests which have been raised both in Egypt and in China In the former case the Egyptians viewed with apprehension the opening up by foreigners of the richest tomb ever found, of which part of the contents at least were to leave the country; the Chinese were aroused by the almost fabulous but entirely fortuitous monetary value attributed to the dinosaur's eggs. In these two instances the circumstances were exceptional, but there is a principle involved which is the crux of international participation in research in which the results are, to a very considerable degree both material and limited in extent No country which has become scientifically self-conscious can view with equanimity the danger that it may be despoiled of its scientific treasures by foreigners, and there is grave danger, unless some equitable arrangement is devised, that this may extend from the collection and exportation of specimens and objects of scientific interest to all prosecution of research in the field by others than natives Something of this feeling is to be discerned in India and Egypt . it appears to be a danger in China It may, perhaps in present conditions inevitably will, crop up in countries in which archæological research is now being conducted under the auspices of a protecting or mandatory power, such as in Mesopotamia That day may still be distant and Palestme

Even countries intellectually advanced are not entirely free from this spirit, and we have on more than one occasion raised a protest against the grant of exclusive concessions for archæological excavation to a single nationality, as for example in Albania and Afghanistan. Again, where the problem of international co-operation has in part been solved by the establishment of archæological schools as in Greece, the number of excavations which may be undertaken by any single school tends to become more strictly limited.

It is impossible not to sympathise with the attitude of those who feel that scientific material, and particularly the evidences of the past history of their country, should not be reft from them by outsiders, especially by mere collectors. A historical site when once turned over by the excavator can never be restored, be he competent or the rever-e Archæological material taken from the country will never be returned. It is to the interest of science itself that a government should claim the right of control through permits and concessions, if only as a safeguard against the incompetent investigator, but much more may be demanded and it is difficult to see where to draw Scientific research in these fields is worldwide in its bearing, and restriction in any one area hampers progress in the whole in the study of the broad problems of origin, development, and distribution Investigation should therefore be undertaken by the best man available at the moment, irrespective of nationality. The results should be made accessible to all by the exhibition of series characteristic of the objects found in museums. readily accessible to the great intellectual centres of the world and by early and detailed publication of the descriptive matter relating to the site or find. How best to reconcile the conflicting interests is a problem for which a solution will have to be found, possibly as a result of some international agreement through machinery such as the League of Nations may afford.

### Science in the Public Services.

The Ministry of Agriculture and Fisheries. By Sir Francis L C Floud (The Whitehall Series.)

Pp x+330 (London and New York G P Putnam's Sons, 1927) 7s. 6d. net

THE Ministry of Agriculture and Fisheries is one of the newer departments of the State. though it only obtained its designation as a Ministry in 1919, it was founded in 1889 as the Board of Agriculture, and took over certain functions which had previously been administered by the Privy Council. Later Acts have extended its interests and powers, but it remains unique among departments of State in Great Britain in that it deals with a special section of the community rather than a particular function of government

The Ministry is concerned with legal and land questions, with statistics, education, research, and labour, but only as they affect farmers and farming, and independently of other departments like the Board of Education which deal generally with one of these matters As the author of this book says at the outset, 'Agriculture and Fisheries are the only industries which have a Cabinet Minister of their own to represent them in the Government" If on one hand this gives a singular unity of purpose to the department, on the other it is the source of constant trials, both to its ministers and officials The industry of agriculture is not unnaturally disposed to regard the Ministry as its own special servant and the minister as its advocate. No other office is so permeated by a public seeking assistance or redress, no other minister is so subjected to advice and admonition. The Minister of Agriculture is indeed allowed but little respite from criticism, and he must not expect any compensation in the way of support from the farmers he represents This may in part explain the fact that from 1914 onwards there have been eleven ministers of agriculture.

The book before us is the work of the recently translated Permanent Secretary of the Ministry, Sir Francis Floud, a man who writes with authority, not only because of his familiarity with every detail of its work but also because of the singular trust and affection that his administration has inspired. The book sets out lucidly and with precision the services rendered by each division of the Ministry, the powers with which it is endowed, and the regulations it is called upon to enforce.

These functions are many and various. On the legal side the Ministry used to determine the tithe rent charge, and is still responsible for redemptions, it is the guardian of common lands, their regulation and possible enclosure; and it is the custodian of the corporate estates of the universities and colleges of Oxford, Cambridge, and Durham, and of Winchester and Eton It controls the acquisition of land for small-holdings and allotments, it has other controls to administer, such as those concerned with certain diseases of animals and plants, with rats and mice and weeds, and with the sale of seeds, fertilisers, and feeding-stuffs. Ministry is further responsible for the expenditure on agricultural education and research in England and Wales. The Fisheries Division is a separate department in petto with its own local authorities to deal with—the fishery boards—its own functions of control over fishing and fishermen, its own research to foster and its own statistics to collect. Kew Gardens and the Ordnance Survey are other self-contained organisations for which the Ministry is ultimately responsible

As regards many of these functions, however, and those the more important, the Ministry is less

the actual executive than the administrative bod. which lays down conditions and defrays, wholly or in part, expenditure incurred by other authorities charged with the execution of the work example, the maintenance of educational agencies like the agricultural colleges and the farm institutes depends chiefly upon funds supplied by the Ministry, but the management of these institutions rests with the universities and kindred bodies, or the local authorities. Again, the research institutes, which are largely founded and supported by the Ministry, are under the control of a university or independent governing body, and their officers, even though their rates of pay are determined by the Ministry, are in no sense civil servants research, as regards fisheries alone is this principle of delegation departed from, for the Ministry's veterinary laboratory and its phyto-pathological laboratory are concerned only with such investigations as may affect the administration of the department

It will be seen that the work of the Ministry is largely of a technical character, and, as Sir Francis Floud states, "the work of the Ministry could not be carried out without the employment of a large number of specialist officers, whose work, though different in character, is just as important as that of the administrative or clerical staff." Sir Francis admits the equal importance of the technical officer, and has always acted on that view, but none the less the system of the office permits of no scientific specialist rising to the rank or pay of an assistant secretary, except the chief vetermary officer. In his view the executive should—

"enlist men who have received a good general education in the schools and universities and give them a thorough training in the routine of a Government Department" "It is far better that the ordinary staff of the Department should make no pretensions to be experts. The important thing is that they should have open and adaptable minds, and the capacity to exercise a sound judgment on the advice or proposals, often divergent and contradictory, which come before them from the experts and the practical men of the industry. There is a distinct technique of administration which must be learnt, and it must be combined with a sense of proportion and a recognition of political, financial, and practical limitations with which the specialist is often impatient."

The case for the subordination of the scientific officer could not be better put, and it emphasises the fact that in the higher ranks, whether it be of a government office or a business, it is the administrative faculty that is the essential, besides which nothing else counts But the advocates of

this traditionally English view have never explained why administrative ability is incompatible with technical knowledge. Men have to be judged as men, and if the irresponsible specialist is apt to be too absolute in his dicta. Government departments are not unfamiliar with the pseudo-administrator whose art is to put a smooth face on things and to anticipate the jumping of the cat

Though the made 'expert' can rarely be brought in to take over the complex routine of governmental administration, it should be open to the young scientific officer who enters the service as a specialist to pass over to the executive and be placed later in the running for the higher offices, but only as he shows himself capable of that type of work. The ideal administrator will possess a critical background of technical knowledge Its absence matters little while departments are mainly regulatory, but as they become increasingly constructive, and the Ministry of Agriculture has had to move in that direction, the need for combining both types of mind will become insistent. Yet the prospects of scientific men in government service are not improving. The Ministry of Agriculture has enjoyed since the War a scientific staff in which the industry has confidence, and a feature of Sir Francis Floud's administration was the sympathetic understanding with which he used it. But it may be doubted whether such a staff can be repeated, so limited are the opportunities likely to be under the alien Civil Service tradition and the pressure on promotion boards of Whitley Councils in which the clerical element dominates.

### The Natural History of Ornithorhynchus.

The Platypus: its Discovery, Zoological Position, Form and Characteristics, Habits, Life History, etc. By Harry Burrell. Pp. ix +227 + 35 plates. (Sydney, N.S.W.: Angus and Robertson, Ltd.; London: The Australian Book Co., 1927.) 25s. S its amplified title indicates, this work does not set out to be a systematic descriptive scientific treatise on Ornsthorhynchus anatonus. It is true that it necessarily includes incidentally a good deal in the way of the morphology and physiology of the animal, but it is entirely in accord with the scheme of the author that detail appropriate to a more academic and systematic treatment of structure and function should be either omitted or subordinated to his main purpose. The book is pre-eminently the product of a genuine field naturalist—a type unfortunately less common

than it used to be—an amateur, in the proper and literal sense of a devoted lover of the animals he knows so well.

His book, as Mr. Burrell informs us, 'is the result of nearly twenty years' personal observation of the Platypus in its haunts while collecting specimens for the University of Sydney and the Commonwealth National Museum' Without any disparagement of earlier contributions to the natural history of the monotremes from the beginning of the nineteenth century onwards, and including those resulting from the special expeditions of Caldwell and Semon, it may safely be said that no such complete story of the life history, habits, and behaviour of Ornithorhynchus has ever been presented as that we have now before us in Mr. Burrell's admirably illustrated pages

The author speaks regretfully of the hindrances to his work occasioned by administrative regulations. Surely some easy mean might be discovered between the former extreme of total neglect of the problem of protection of fauna of such singular interest and scientific importance, and the more recent extreme of a well-nigh indiscriminating prohibition of collecting even for disinterested scientific purposes. Is it too much to hope that the recently organised Commonwealth Bureau of Scientific and Industrial Research may be empowered to exercise a wisely advisory function in the regulation of local scientific activities of this nature, whether conducted by Australian or extra-Australian agencies?

Meanwhile, one can only admire the tenacity with which Mr. Burrell has pursued his task in spite of all obstacles, and gratefully welcome the very substantial contribution he has been able to make to the natural history of the archaic mammal the intimate life of which he has so successfully investigated. Only those, perhaps, who, like the present writer, have themselves essayed the pursuit of the same difficult quest, both personally and by proxy, can adequately realise what that tenacity and that success really mean

The earlier chapters of the work before us, dealing with the discovery and early descriptions and with the former controversies on the zoological position and the oviparous character of the animal, are of slighter importance to the present-day zoologist. Yet they do, no doubt, provide a useful résumé for the non-scientific reader, especially in Australia, of the growth of knowledge concerning an animal the unique features of which have all along presented a problem of unusual interest.

Chapters v.-vii, on general characteristics, on

nervous organisation and sensory perceptions, and on the spur and crural gland, contain a good deal of useful information, much of which is from firsthand observation—the last of these sections, however, seems unnecessarily diffuse

It is the latter half of the book, from Chap, vni onwards, which will more especially engross the interest of the student of natural history. Chap viii treats at considerable length of the elaborate nesting burrow and its construction. On this subject the author can speak with the knowledge and authority derived from long, laborious, and fruitful investigation. The value of his account is also greatly enhanced by an admirable series of photographic illustrations.

Chapters ix. and x are concerned with the general habits, food, and domestic economy of the animal. Chap. xi. will perhaps most of all attract the attention of the zoologist. In it are set forth Mr Burrell's original observations on mating, egglaying, hatching, and the growth of the young to adolescence. How well qualified the author is to contribute to our knowledge of these matters may be inferred from his record of personal observation of no fewer than seventy tenanted nests. Here again his statements are supported by a number of excellent photographic illustrations, amongst which those showing twin and triplet nestlings in their nests are specially noteworthy.

The final chapters deal with the subjects of 'preservation and economics,' and with that of the Platypus in captivity. It is no small achievement to have succeeded in keeping alive under observation and in good condition for months at a time, specimens of an animal so delicately adapted to its own natural conditions as Ornithorhynchus.

In the way of actual criticism, it may perhaps be said that when Mr. Burrell does descend to the discussion of morphological or physiological details, he is on less sure ground. Thus, for example, it cannot be admitted that (p. 67) the olfactory nerves are "relatively large" in a mammal that has by some authorities been classified (albeit with insufficient justification) as actually 'microsmatic.' In this connexion, too, one might have expected some reference to be made to that still enigmatical olfactory dependency, the vomero-nasal organ of Jacobson, which in Ornithorhynchus is of such imposing and well-nigh reptilian proportions and is almost, if not quite, the largest amongst mammals. To the nerves connected with this quasi-olfactory apparatus the apparent 'olfactory' nerve owes a fair share of its own quite modest proportions. It is searcely too much to say that the discussion of the organs of sensory perception as a whole is weak and sketchy. The reference on p. 70 to the lateral line organs of fishes betrays a misconception of their real function. It is to be hoped that in any subsequent issue the reference, in Plate 3, to the openings of the naso-palatine canals as the 'nostrils' will be corrected, as well as the misleading legend 'jawbones' in Plate 4

The bibliography at the end of the book is clearly in no sense a bibliography of Ornithorhynchus Presumably it is meant to refer only to the topics dealt with in the book itself But even in this sense it is far from complete. Although in Chap. vi a slight attempt is made to deal with brain characters, no references are given even to the most important literature on this branch of the subject, including the work of Turner, Elliot Smith, and Ziehen Agam, whilst the characters of the snout or muzzle are correctly insisted on in the chapter on general characteristics, no reference is given to controversy on this subject in 1894 (cf. Proc. Linn. Soc N.S W, vol. 9, Ser. 2, p 688).

Any minor faults of omission and commission which the book may show are amply atoned for by its conspicuous merits in the direction of the author's authentic interest. Judged by its own proper criteria, Mr. Burrell's book must be pronounced to be a contribution of considerable value to the literature of the natural history of the Mammalia, a testimony to the industry and enthusiasm of its author, and a credit also to its enterprising Australian publishers

J. T. W.

### A Persian Oil Field.

In a Persian Oil Field: a Study in Scientific and Industrial Development By J W. Williamson
Pp. 189+24 plates. (London: Ernest Benn, Ltd., 1927.) 7s. 6d net

HE Tigris and Euphrates jom north-west of Basrah and thence flow to the Persian Gulf as the broad, silt-filled stream known as the Shatt-el-Arab. For some hundred miles the combined rivers wind their way between low banks of alluvium, on which, except for the small areas cultivated around the Arab villages, nothing of value grows save the date palm. The scene and the surrounding country have probably been much the same for the past two thousand years, although evidences of Roman irrigation works indicate that, at one time, vast areas of the country must have been under effective cultivation and have remained so until the system, lapsing into disrepair, enabled the highly charged waters of the two rivers again to impreg-

nate the soil with mineral salts so as to render it productive of little but the camel thorn

If conditions are favourable, a traveller on the mail-boat from Bombay usually passes the bar at the mouth of the Shatt-el-Arab during the evening. and for the next few hours steams up the river between dark and inhospitable banks Suddenly in the far distant sky a blaze of light is reflected and the ship passes a veritable town-hip brilliantly illuminated and teeming with industrial life. Thereafter, until Basrah is reached, there is again nothing but the blackness of the unmhabited desert contrast is so great that the traveller finds it difficult to believe that twenty years ago this township was also part of the desert and that it was here that the first pioneers, many of whom are still active in the Company's service, started to build the piers and jetties from which at the present time a large proportion of the oil is transported to the home refineries at Llandarcy and Grangemouth it was here, at Abadan, that the Anglo-Persian Oil Company decided to build its refinery and loading station at the head of the pipe lines which carry the crude oil from the 'Fields' some 150 miles distant northward across the desert

The book under review contains a description of the country developed by the Company, and is the outcome of a visit paid by the author during the cold weather of 1926. It is divided into two sections—Part I. "The Science," and Part II. "The Humanities"—and constitutes a striking record of British mitiation and achievement which is good to read.

Although the author disclaims any intention of producing a technical book, yet it is evident that his wide knowledge of general science has enabled him to impart to Part I. of his book a breadth of view and of sympathetic treatment which throws the policy of the Company in regard to the development of the scientific side of its activities into strong The scientific problems of the Persian oil field are unique, and can be solved only by systematic research in which the chemist and physicist must combine to help the geologist and engineer. Much has been achieved, but much remains still to It is evident from the author's record be done · that great and successful efforts are being made to meet the inherent difficulties of the situation

For one who has had an opportunity of visiting the places he describes, it is of particular interest to note the able manner in which the author takes the reader by the hand and leads him through the various phases of oil production, beguiling him with pleasant but instructive conversation by the way, yet refraining from satiating him by the glib talk of

millions—for statistics, however veracious, are apt to produce a state of repletion from which the ordinary reader usually emerges in a condition of static disbelief

Part II . dealing with "The Humanities," records a system which any industrial organisation might follow with advantage to itself and its workers. It describes the means adopted by the Company to render the lot of its European staff pleasant and congenial. An account is also given of the housing and care of the native worker, and of the means taken to educate his children. Above all, attention should be directed to the description of the admirable medical service, which, under the care of the medical directorate, has reached a degree of efficiency probably without parallel

The illustrations of which there are a large number, are excellent and are very clearly reproduced. Without question, the author is to be congratulated on having produced a thoroughly readable volume which places on record, in a manner understandable by all, an epic of achievement of which all Britons must be proud.

JOCELYN THORPE.

### Maxwell's Scientific Papers.

The Scientific Papers of James Clerk Maxwell Edited by W. D. Niven. (Photographic Reprint by arrangement with the Cambridge University Press) Vol 1. Pp xxxii+607. Vol. 2. Pp. viii+806 (Paris. J. Hermann 1927) 3 livres 6.

T is not often that a reissue of the collected papers of an outstanding scientific man has been called for. Some of the papers cannot fail to have historical value because of the part which their original publication played in the development of science. but that value alone would not be sufficient to secure the demand The work involved must be of present-day importance. Therefore its consequences must still be in process of development, and it follows that if, as in the present case, the republication follows the first publication after an interval of half a century, the mam papers involved must have been of very epoch-making type. The condition of present value is a sufficient test; but the most essential condition is that of permanent value. Present value persisting after the lapse of fifty years suggests permanence, and at least points to some enduring quality—the direct impress of the distinctive personality of the man.

How much might be attainable in that way was made clear at the threshold of Maxwell's scientific life when it was said of him by his Cambridge tutor that it seemed to be impossible for him to think wrongly on a physical subject. How much had been attained in its brief duration was perhaps most impressively made evident by the incident of the entry into a railway carriage at a Dumfriesshire station of a countryman who took his seat with the single remark, "Maxwell is dead"

It may be sufficient to refer, in illustration merely, to the three main lines of investigation which are dealt with in the papers In the subject of colour vision, the work of the man who, simultaneously with and independently of Helmholtz, introduced for the first time methods of precision into a previously vague field of inquiry, is still of value to a multitude of workers; for he dealt with the best methods which could be used In the subject of the electromagnetic field and its properties, the results of his epoch-making inclusion of optical phenomena are of fundamental importance in the now pressing investigation of the state of ionisation of the upper atmosphere. Experience has verified the soundness of his judgment regarding the form of the equations of the field; and new discovery regarding electrons has led to the natural extension of the equations, on his own lines, by the recognition of electric currents of convection. In the subject of molecular theory, his work has recently been finding its verification alike in the field of things smaller than atoms, whereof knowledge had not reached him, and in the field of a stellar universe wherein the atoms are suns. This is an interesting astronomical reversion if his molecular investigations arose in connexion with his work on the rings of Saturn.

The student who desires to follow Schrodinger in his endeavour continuously to bridge the gaps indicated by the modern atomic and quantum postulates and to restore to the physicist the Maxwellian ether, of which some relativists thought they had deprived him, could not do better than read as a preliminary the papers in which Maxwell applies the Hamiltonian characteristic function to the solution of some optical problems. In the perusal of any of the papers the student will learn something of the mode of working of the mind of one who was a master amongst masters. It is not possible for a student to make too much use, in that way, of the works of the great thinkers. Thereby he may at least train himself to heighten the value of whatever work he does.

To the Cambridge University Press and to the firm of J. Hermann are due the thanks of physicists for the completion of a greatly needed reissue. The quality of the photographic work, and of the general technique, is high.

W. PEDDIE.

No. 3031, Vol. 120]

### Our Bookshelf.

Bauxite a Treatise discussing in Detail the Origin, Constitution, known Occurrences, and Commercial Uses of Bauxite: and including Particulars regarding the Present Condition of the Aluminium Industry and the Peculiar Importance of Cryolite in the Extraction of Aluminium from Bauxite By Dr Cyril S Fox. Pp x+312. (London: Crosby Lockwood and Son, 1927) 30s net.

With the increasing popularity of the metal aluminum, increasing interest is being taken in its principal ore, bauxite, and Dr Fox has opportunely provided a trustworthy and comprehensive treatise on the occurrence and uses of this substance. He distinguishes two principal modes of origin, the terra rosa (sic) type representing the insoluble residue of great masses of soluble limestone or dolomite, and the lateritic type resulting from the decomposition in situ of original aluminous rock. The former occurs mainly in the Mediterranean region of Europe, and the latter in the tropical monsoon lands of Asia, Africa, and America.

The largest known reserves of ore are of the lateritic type, and the author's descriptions of typical occurrences are of great interest and value. There will be general agreement with his conclusion that lateritic bauxite and lateritic ironstone stand at opposite ends of a series of tropical decomposi tion products, of which true laterite with, theoretically, equal quantities of hydrated ferric oxide and trihydrate of alumina occupies the middle. Dr. Fox gives a useful summary of current opinion upon the nature of the process of lateritic weathering in the tropics, and suggests a number of conditions which seem to him necessary for the formation of laterite. The economic aspects of the bauxite and aluminium industries are discussed in considerable detail and supported by statistical information The book is well printed and well illustrated, and the author is to be congratulated on producing: work which meets a pressing need of the day

Modern Bee-Keeping. By Herbert Mace. Pp. 225 +xix+16 plates. (Harlow, Essex The Publisher, Modern Bee-Keeping, 1927) 5s. net.

HAVING chosen such a title as that of "Modern Bee-Keeping," the author might be expected to show familiarity both with modern apicultural practice and also with the recently ascertained facts of science. He repeats, however, without comment, the old statement that Braula cæca is pupiparous, even though the egg and larva have been figured by several observers, and the damage done by the larval tunnels in the cappings of honey has actually been illustrated in an English-speaking bee journal.

Agam, the old theory that the brood food is regurgitated chyle is given here as an undisputed fact, whereas the opposing view that it is a secretion of the lateral pharyngeal glands is the one more generally held at the present time. Referring to races, the author confounds the brown German bee of pre-Isle-of-Wight days (Apis mellifica L.) with

the black heath bee (Apis mellifica var Lehzeni) of Holland and parts of France

In the chapters on disease, much confusion of thought as to etiology and causative organisms is shown, both in referring to brood diseases and also diseases of the adult bee, which are all brought together under the term. Isle of Wight Disease." Remedial measures are given, sometimes without making it clear for which disease they are intended, and without insisting that a correct diagnosis is necessary before prescribing

It would be easy to continue to criticise the scientific part of the book, and the same could be done with the part dealing with practical methods, but here we are dealing with matters of opinion. Suffice it to say that many of the operations should be condemned as being calculated to spread bee diseases rapidly through the apiary.

D. M.

The General Theory of Thermodynamics: an Introduction to the Study of Thermodynamics. By Prof J E Trevor Pp. x+104 (Boston, New York, Chicago and London Ginn and Co., Ltd., 1927.) 1 60 dollars

THE object of Prof. Trevor's book is to "develop the general laws of Thermodynamics with logical consecutiveness and mathematical clarity for students of physics, physical chemistry and engineering, for mathematicians and practising engineers. No applications of general principles are considered. The treatment departs considerably from traditional lines, as would be expected from the author's paper in the Journal of Physical from the author's paper in the Journal of Physical . Chemistry, 1908, and familiar words and phrases are used in new and disconcerting senses. Thus when a weight w is raised a small distance dh, "the inexact expression wdh denotes the work absorbed " (p 12). The equation dE = dW + dQ "asserts that the work and heat absorbed are integrals of exact differential expressions" (p. 13) In connexion with the pv diagram, "an irreversible path cannot be depicted by a curve in the plane "(p. 18). The law of dissipation runs, "when a thermally and dynamically isolated body undergoes a change of state that admits of a reversible path, the change of the entropy of the body is positive "(p. 85), which appears unduly restrictive. In later chapters, for example, that on the porous plug experiment, the treatment conforms more to tradition. It is not easy to understand how the book can serve as "an introduction to the study of thermodynamics.

Memoirs of the Geological Survey of England and Wales Explanation of Sheet 232: The Geology of the South Wales Coalfield. Part 2: Abergavenny By Aubrey Strahan and Walcot Gibson, with Notes by J. R. Dakyns and Prof. W. W. Watts. Second edition, by Dr. T. Robertson. Pp. x1+145+4 plates. (London: H.M. Stationery Office; Southampton: Ordnance Survey Office, 1927.) 3s 6d. net.

The first edition of this important memoir was published in 1900,  $\varepsilon$  d the need for a new edition has been made the coasion of certain additions and corrections, none of which can, however, be said

to be of any serious importance. A good deal of palæontological work has been done, especially perhaps in the Millstone Grit. Naturally, the active development of the colheries during the last quarter of a century has thrown valuable light upon the structure of the coalfield. The Carboniferous Limestone has been exhaustively studied and the question of its dolomitisation has been examined in detail. The fact that a quarter of a century of active work has necessitated so little change in any of the fundamental portions of the memoir is evidence of the care and thoroughness with which the work was originally done.

Soil Conditions and Plant Growth. By Sir John Russell (The Rothamsted Monographs on Agricultural Science.) Fifth edition. Pp viii + 516+6 plates (London Longmans, Green and Co., Ltd., 1927.) 18s. net.

This well-known text-book has now reached its fifth edition, a sufficient proof of its value and The last edition has been revised in popularity the light of the author's recent travels abroad, during which he has had many opportunities of seeing the work of other stations. Nevertheless, the book retains its original character, and continues to give great (and no doubt well-merited) prominence to the work of Rothamsted. recent years that has been largely concerned with soil biology in what may be loosely termed its purer aspects, but the agronomist feels that field results have followed slowly and is glad that soil tillage—which exercises a profound influence on the soil flora and fauna—is now engaging the serious attention of Rothamsted. We doubt also whether sufficient prominence has been given to the work of other soil laboratories, such as Bangor The recent revolution in the methods of soil analysis, as referred to in App. I., for example, is due entirely to the original work carried out there.

Some Nigerian Fertility Cults By P. Amaury Talbot. Pp. xi+140+16 plates. (London. Oxford University Press, 1927) 12s. 6d net

Mr. AMAURY TALBOT here describes the beliefs of the Ibo and Ijaro tribes of the Degamo division to which he was posted in 1914 For the most part they centre around the cult of Ale, the Mother-Earth goddess, and her consort, the Thunderer. Mr. Talbot describes at some length the M'bari houses or shrines and the ceremonies connected with them. He has brought considerable acumen to bear on the interpretation of these rites; but perhaps his most pregnant suggestion is made in connexion with the cult of the Great Drum. By an ingenious line of reasoning, he unravels the symbolism of the representation of the tortoise and identifies it with the female pudenda. Of the many ceremonies and beliefs connected with the promotion of the fertility of the crops which serve to illustrate the principles of the "Golden Bough," the most striking is that relating to the priest of the Elele Yam cult, whose office, like that of the priest of Nemi, reverted to the man who succeeded in slaying him.

### Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can be undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. No notice is taken of anonymous communications.]

## The Diffraction of Cathode Rays by Thin Films of Platinum.

In a letter to NATURE of June 18, Mr Reid and I described the rings formed when a beam of cathode rays was sent at normal incidence through a thin film of celluloid and struck a photograph plate placed some distance behind the film These were attributed to a diffraction of the cathode rays by the film, the cathode rays behaving as waves of wave-length himv according to de Broglie's theory of wave mechanics, and regularities in the structure of the film, or in the size of the molecules, making it behave as a kind of In a paper now awaiting publicadiffraction grating tion by the Royal Society, this work has been confirmed and extended to films of gold, aluminium, and of an unknown (probably organic) substance. In particular, the relation that the size of the rings is in all cases inversely as the momentum of the cathode rays is fully confirmed, and the number and size of the rings correspond remarkably with what is to be expected from the known crystalline structure of gold and aluminium, using de Broglie's expression for the wavelength of the cathode rays.

The present letter describes an extension of these results to the case of platinum. The difficulty was to get a film of platinum sufficiently thin to permit of the passage of the cathode rays without so much scattering as to mask the rings. One method was to obtain a thin film of platinum by cathodic spluttering on glass and removing the deposit by hydrochloric acid. This gives films thin enough to be transparent and several millimetres each way, but when they were mounted on frames, they always broke during the course of drying. To avoid this. I tried mounting them on the thin celluloid films used in the earlier experiments. This, of course, has the disadvantage that one would expect to get the rings due to both celluloid and platinum superposed. However, the most marked celluloid ring is about half the size to be expected for the smallest platinum ring, the other celluloid rings being very faint, under the conditions of experiment. It was found that when a photograph taken with platinum on celluloid was compared with one for celluloid alone, several new rings appeared. The photograph (Fig. 1) shows the innermost and strongest of these, the celluloid ring inside being visible only as a disc owing to over-exposure. In addition there were two new outer rings too faint to reproduce. Photographs were taken of these rings with various speeds of rays, and the size varied inversely as the momentum within the errors of experiment.

Since platinum is a face-centred cube of side  $3.91 \times 10^{-8}$ , the distances d between successive crystal planes are given by  $\frac{3.91 \times 10^{-8}}{\sqrt{h^2 + k^2 - l^2}}$ , where h, k, l

are the indices of the plane, to be so chosen that they are all even or all odd. The smallest values of the denominator are  $\sqrt{3}$ ,  $\sqrt{4}$ ,  $\sqrt{8}$ ,  $\sqrt{11}$ ,  $\sqrt{12}$ . Each of these spacings gives a ring in the Debye-Scherrer method of X-ray analysis, and if the view that all particles behave like waves is correct, should do so with cathode rays also, assuming that small crystals orientated at all possible angles to the beam are present in the film. It is believed that the ring illus-

trated is a compound of the  $\sqrt{3}$  and  $\sqrt{4}$  ring unresolved (in the case of gold, which gives better films, the corresponding rings have actually been resolved), the two outer rings being  $\sqrt{8}$  and an unresolved compound of  $\sqrt{12}$  and  $\sqrt{11}$ . Taking the diameter of the inner ring as the mean of  $\sqrt{3}$  and  $\sqrt{4}$ , the diameters of the outer rings are  $\sqrt{8}$  2 and  $\sqrt{11}$  1 as a mean from four plates. The absolute size of the rings is given by the Bragg law  $n\lambda = 2d \sin \theta$ . Taking the inner ring and using the above formula for  $\lambda$ , I find for the side of unit cube 3.75 × 10-8 (mean of 6 plates) against 3.91 × 10-8 as found by X-rays. This is 4 per cent. low, and would be about 6 per cent. low if the

relativity correction were put in The values found for gold and aluminium were also low by about the same amount This may be due to a systematic experimental error, or may have a theoretical reason (for example, be analogous to the Compton effect) These results

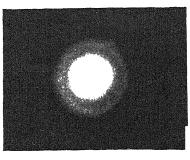


Fig 1.

have been confirmed by some experiments with a thin piece of platinum further reduced in aqua regia. Though this was still too thick as a whole, it must have had thin patches, as photographs showed, besides spots due to holes and the direct beam, other 'diffracted' spots airanged in circles round the centre. These are explained by supposing that in this film, which had probably been originally made by rolling, the crystals were not situated in all possible directions, and so did not give complete Debye-Scherrer rings, but only spots on them, more like a Laue pattern. It was possible to distinguish between the spots corresponding to the two inner rings, and the ratios of their distances from the centre were  $\sqrt{3} \cdot \sqrt{4\cdot 2}$  (mean of two plates).

The energy of the rays used in these experiments varied from 30,000 to 60,000 volts, and the distance from film to plate was 32 5 cm G. P. Thomson.

University of Aberdeen, Nov. 17.

Note added in proof.—Using a very thin piece of platinum leaf, I have now been able to obtain rings similar to those described above, without the use of celluloid backing. The inner ring is resolved into two as in the case of gold.

### Method of Fossilisation of an Insect Wing.

In has long been known that when the wing of an insect becomes fossilised the original chitin is either completely destroyed or else replaced by some other substance, such as carbon, silica, or oxide of from This, however, does not explain the extraordinary perfection with which some insect wings have been preserved, even in Palæozoic strata. A recent study of two thousand fossil insects from the Lower Permian of Kansas, approximately two hundred milhons of years old, has brought to light many specimens in which the wings are as perfect as if they had just been dissected from the insect, yet it is evident that three original chitin is not present, neither is it replaced by any other substance. The explanation of this is to be found as follows:

The wing of an insect is really a bag the sides of which have been brought into contact and fused together

except along the vein-channels. Thus there is an upper side formed of one layer of chitin, and an under side formed of a second layer in contact with the flist. The chætotary, or armature of hairs, is usually different on these two layers. Now, when a geologist flinds a rock specimen containing an insect wing, he may, if he is lucky, succeed in splitting it with a blow of the hammer in such a way that he obtains two perfect impressions, these are called the obverse, in which convex veins appear convex in the impression, and concave veins concave, and the reverse, in which convex veins appear concave, and vice versa.

A little consideration will show that it we took impressions of the upper and under surfaces of the wing of a recently killed insect, in dental wax or pla-ticine, it would be the upper surface which would give the reverse impression and the under surface the obverse impression. Now, in the Kansas fossils there are many in which both impressions are preserved perfectly, with colour-pattern complete. This is par-

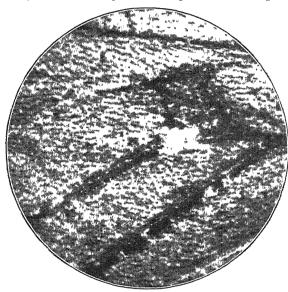


Fig 1—Lemmatophora tupuca Sellards, ramily Lemmatophoride, order Protoperlaria, Lower Permian of Kansas, U.S.A. Portion of reverse impression (upper surface) of foreving, showing the chartotaxy of numerous microtrichia. (Much enlarged)

Photo by W. C. Davies, Curator, Cawthron Institute

ticularly true of the fine species Lemmatophora typica Sell., already figured in NATURE (June 12, 1926, Fig. 2), and typical of the extinct order Protoperlaria, ancestral to our recent Perlana or Stone-flies accompanying illustration (Fig. 1) shows a small portion of the reverse impression, greatly magnified, from the region of the cubital fork of the following. The chætotaxy consists of an immense number of inmute hairs or inicrotrichia, resembling those of recent Perlaria, but somewhat stouter and shorter. This armature of fine hairs, then, must have been originally on the upper side of the wing in the living insect It, however, we examine an obverse impression from the same species, we find much smaller and more slender microtrichia present, together with a row of strong spines along the costal margin (evidently of use in preventing the forewing from folding too far back over the hind in the position of rest).

Thus we see definitely, for the first time, that the two impressions on the rock are actually the separate impressions of upper and under surfaces of the wing, and that they are separated by the exceedingly slight but measurable space represented by the thickness of the disintegrated chirm of the wing. The reason

why the impressions are so perfect appears to be, not only that the grain of the rock is so fine that even the timest hair has left its impression, but also because the pigments of the wing, unlike the chitin, have proved indestructible, and are actually preserved on the rock, even in the case of the timest coloured hair! That this is so can be simply demonstrated by exposing one of the coloured fossils to bright similght, when it will be found to fade markedly after a few hours only, just as the pigment in the wings of butterflies fades in museum cases exposed to the light.

R. J. TILLYARD.

Cawthron Institute, Nelson, N.Z., Sept. 21.

#### Abel's Pituitary Tartrate.

In 1919, Abel and Kubota isolated from the pituitary gland a single principle which they identified as (a) histamine, (b) the plain muscle-stimulating and depressor constituent. This conclusion, which they upheld in 1920 and withdrew in 1921, implied that the pressor constituent was not the plain musclestimulating (oxytocic) or the depressor substance. In 1923, Abel, Rouller, and Geiling prepared a tartrate from pituitary extracts 1250 times as active on the uterus as histamine and phosphate. This tartiate, they asserted, contains a 'single principle' responsible for the pressor, oxytocic, diuretic, and depressor activities. About the same time Hogben and Schlapp, studying the inversion effect, that is, the depression following a second injection of commercial extracts in the cat, found that with alcoholic extraction the depressor activity of their own preparations gave a diminishing depressor response, so that, with a powder made from glands put in icecold acetone immediately after killing, extraction for forty-eight hours resulted in a preparation which, with undiminished pressor activity, elicited no depressor action when administered in quantities equivalent to one hundred times the threshold for the pressor effect.

This was fully consonant with observations previously made by Schafer and Vincent, and with the properties of highly concentrated pressor fractions prepared by Dudley (1923), who in collaboration with Dale (1921) had advanced evidence indicative of the separate identity of the oxytocic and pressor substances. The work of the latter was confirmed independently first by Dreyer and Clark (1923) and later by Fenn (1924). Using a method of pressor assay designed by Hogben, Schlapp, and Macdonald to give an accuracy as great as that obtained with Dale's procedure for standardisation of the oxytocic principle, Schlapp (1925) conclusively proved the possibility of separating the two constituents by Dale and Dudley's method, that of Dreyer and Clark, and by a new procedure of his own. At the end of last year there appeared in *Physiological Reviews* a résumé of recent work on the pituitary gland from Abel's laboratory. In it Geiling maintained the validity of the claims of Abel and his co-workers to have concentrated a 'single principle' to which the manifold pharmacodynamic properties of pituitary extracts can be attributed Beyond the bare statement that Abel and his colleagues were not able to subscribe to Dale and Dudley's contention, no attempt was made to explain why several groups of workers had been successful in concentrating the pressor and oxytocic activities in separate fractions. With reference to the inversion effect, however, Geiling made the

"Unpublished experiments of the writer show clearly that even after a defatted pituitary powder has been extracted forty-eight hours in a Soxhlet with absolute

following pronouncement:

alcohol, as described by Hogben and Schlapp, it will still produce, when injected into etherised cats, either with mact or with cut vagi, and in the same doses as used by Hogben and Schlapp, a lessened response with the second injection, and later injections will effect the inversion. Hogben and Schlapp are in error, when they assert that the fall in pressure is due only to the depressor substance and is not an intrinsic property of the infundibular extract. (Italics inserted)

Owing to departure from the American continent, the present writer was prevented from replying at the time to this ex parte and undocumented statement in what one presumed to be an impartial survey of existing literature. Two subsequent publications, however, one by Vincent and Curtis (Endocrin, 10), and one by Draper (Am Jour. Physiol., 80), together with the text of Geiling's experiments (Geiling and Campbell, Jour. Pharm. Exper Ther, 29), now call for comment on the claims of Abel and his collaborators to have concentrated a 'single principle'

As regards Geiling and Campbell's experiments, it is to be noted that they admit having used a commercial preparation, and frankly state that "the outstanding feature of their experiments was the variability in the development of a depressor response." Their tracings show no saline controls, and, where an undoubted depressor effect is indicated, the dosage was much greater (five times) than that used by Hogben and Schlapp. they made no quantitative comparison of depressor activity during the progress of extraction, an essential point in the thesis of Hogben and Schlapp; and, finally, they seem to have obtained their very transient depressor effects by rapid injection of cold extract. It now appears from Vincent and Curtis's paper, which upholds the view that the depressor action of pitutary extracts is due to a separate substance, that rapid injection of cold salme can of itself produce the type of depression which Campbell and Geiling obtained.

Whatever be the truth with regard to this issue, there is now little room for doubt about the separate identity of the oxytocic and pressor substances. Draper (1927) has repeated Schlapp's work, using the improved method of pressor assay, and a method of diuretic standardisation devised by himself for the purpose. His observations, like Schlapp's, Fenn's, and those of Dreyer and Clark, confirm the view of Dale and Dudley. In addition, Draper directs attention to a point which, in view of the aggressive tone of Geiling's review, is worthy of quotation:

"A study of these data [i.e. those of Abel, Rouiller, and Geiling] reveals the fact that the three activities were not preserved in their original proportions. On the connot preserved in their original proportions. On the contrary a great loss of the pressor and duretic activities seems to have taken place. . . . 0 2 mg. of a tartrate having an oxytocic titer of 500 times histamine acid phosphate is shown to cause a slight rise of blood pressure in an anæsthetised cat, and 0.05 mg. is shown to produce a submaximal diuretic effect in an anæsthetised rabbit. These doses had the oxytocic activity of 100 mg. and 25 mg. of histamine acid phosphate respectively, and were the oxytocic equivalent of 100 cc. and 25 c.c. of the liquor hypophysis U.S.P. ix Since one tenth to one hundredth of a c.c. of liquor hypophysis is sufficient to raise the blood pressure of a cat and to promote diuresis in a rabbit, it is evident that these activities had been almost completely destroyed or eliminated in the process of purification.

In short, if Abel and his associates have evidence, as yet unpublished, to support Geiling's statement that "all the physiological properties of our active substance increase in intensity and in the same ratio parı passu," it is unfortunate that such data have been withheld from other groups of workers. The data they have placed at the disposal of other investi-

gators prove the very opposite If, on the other hand, no such data are available, one may hope that Abel will relinquish his claims to have concentrated a 'single principle' with the same candour as he displayed in withdrawing his previous view that the oxytocic and depressor substances were different from the pressor and identical with histainine.

LANCELOT HOGBEN.

University of Cape Town, Sept 1.

#### Oceanic Deeps and the Thickness of the Continents.

In a recent paper dealing in part with the structure of the lithosphere (Geological Magazine, June 1927) I assumed the substratum of the floor of the Pacific to be mainly eclogite, and I hinted at the possibility that the great bordering deeps of that ocean might mark the sites of great intrusions of peridotite. This speculation, however, fails to accord with the requirements of isostasy and is therefore unsatisfactory. An analysis made by Hiller (Gerlands Beitrage, 1927, p. 279) of the velocities of long waves which had followed widely different paths around the upper layers of the lithosphere seems, moreover, to rule out the identification of the Pacific sima with eclogite. For waves having a period of 18 to 20 seconds, Hiller finds velocities of 37 km. per sec. in the material of the Pacific floor, and 29 in that of Europe, Asia. and America. He adds that these are the respective velocities to be expected in sima and sial. Comparison of the ratio of these velocities (1 27) with that of the corresponding P- or S-wave velocities in gabbro and granite (1.23), indicates that the floor of the Pacific down to a depth of the same order as that of the sial of the continents behaves as gabbro would do

If this identification be adopted, a reasonable explanation can be offered to account for some of the more puzzling features of the oceanic deeps. The effect of intense compression on a thick floor of gabbro would be, not to produce mountains or submarine swells, but to transform the gabbro mto its high-pressure facies, eclogite. The change of density from 3 to 3.3-3.5, and the simultaneous action of isostasy, would therefore lead to marked subsidence, and a deep would result. On this hypothesis we should expect to find deeps along belts where the ocean floor borders the compressed mountainous edges of the sial; precisely, in fact, where they do occur. Deeps, moreover, should not occur everywhere around such borders, for in many places a thin covering of sial over the original gabbro would effectively prevent their development.

Thus, the two kinds of material, sial and sima, adopted by Wegener to explain the two dominant levels of the earth's solid surface, continental and oceanic respectively, serve equally well to explain the upward and downward departures from those levels. Compression and over-thrusting of the sial increase its thickness without seriously altering its density. and so lead to the uplift of plateaux and mountain ranges. Compression of the sima along adjacent belts (if the sima be normally of gabbroid composition, and free from even a thin covering of sial) results in a marked increase of density, and so leads to the formation of the greatest tracts of subsidence—the occanic deeps.

If now we assume the following approximate data: Sial: mean density, 2.7 (ranging downwards in composition from granite to diorite, apart from its

superficial veneer of sediments);

Sima: mean density, 30, where composed of gabbroid material, and 34 where this is in the eclogite facies, or where the sima is composed of

we can balance a sial column through, say, Tibet, with an average altitude of 5 kin., against an eclogite column through an oceanic deep covered with, say, 8 km. of sea water If x be the depth of the level of equal pressure below sea-level, then approximately

 $2 \cdot 7(x-5) = 8-34(x-8)$ ; giving x = 467 km.

Applying this method to the average floor of the Pacific, we easily deduce a thickness of 25 km of gabbro underlain by 34 material (eclogite or peridotite); and finally, for the sial thickness corresponding to continental regions of average elevation we arrive at about 31 km., also underlain by 3.4 material In support of this figure the latest estimate made by Dr. Jeffrevs may be cited. His investigations of the records of the Jersey and Hereford earthquakes of 1926 indicated in each case a granite layer of about 10 km., underlain by an intermediate layer approximately twice as thick (M.N.R.A.S., Geophys. Suppl., I., 1927, p. 483). If I am right in interpreting the composition of the intermediate layer as quartzdiorite to diorite, then the sial of the neighbourhood of Great Britain, the North Sea, the English Channel, and the adjoining parts of Europe—a nearly average region, though slightly low-should be about 30 km.

Dr. Lawson and I have previously shown that radioactivity appeared to set a limit of 15 or 20 km. to the average thickness of the sial (Phil Mag, Dec. 1926, p. 1218). If, then, this thickness be really 30 km., it becomes certain that the radioactivity of the sial must fall off very rapidly in depth. Probably the most remarkable evidence supporting this hitherto , little explored possibility is to be found in the atomic weight and isotopic constitution of common lead. These show quite conclusively that no appreciable part of the latter has been derived from the disintegration of uranium and thorium during known terrestrial history. Otherwise the atomic weight of ordinary lead would range between 206.9 or less, and 207.2 or more. That there is a real distinction between ordinary lead and radioactively generated lead has now been finally demonstrated by Dr. Aston's recent success in obtaining the mass spectrum of lead (NATURE, Aug. 13, 1927). It follows from these results that, until the time of its dispersal through and concentration from magmas, the lead of common ores must have lain in an environment where it was not appreciably affected by admixture with generated lead. In other words, I suggest that the dioritic base of the sial through which ordinary lead may originally have been dispersed, is extremely poor in the radioactive elements uranium and thorium, relative both to the higher levels of the sial and to the underlying levels of the sima.

. Thus we see that an estimate of 30 km. (or a little over) for the mean thickness of the sial is in accordance with such widely different phenomena as the great depths of the oceanic deeps and the practical invariability of the atomic weight of ordinary ore-lead. Smaller estimates of thickness appear to leave ARTHUR HOLMES. both quite unexplained.

The University, Durham, Oct 28.

### The Golgi Apparatus in Higher Fungi.

THE Golgi material in plant tissues is only now being worked out Guilliermond of Paris in 1922 obes deligi apparatus in barley roots by the silver intation mon method; and in March 1926 he publicularly it aper in C R. Acad. Sci.. Paris, on the If the two itween the plant vacuolar system and the

Golgi apparatus. He treated the epidermal cells of very young leaves of Iris germanica and meristematic tissues of young shoots of Elodea canadensis. some Chlarophyceæ, Cyanophyceæ, bacteria, and some fungi (Levure and Oidium lactis), with the silver impregnation methods of Cajal and da Fano as well as with vital staining with neutral red. In the majority of cases he could obtain the precipitates of vacuoles (metachromatic corpuscles) stained in the form of the network of canals constituting the Golgi apparatus.

Botanists generally are of opinion that the plant vacuolar system and the Golgi canals of animal cells are morphologically and physiologically equivalent. This is further supported by the recent remarkable researches of Parat, who has shown that the Golgi apparatus in animal cells also consists of a number of vacuoles. By the silver nitrate method of Golgi I have obtained clear blackened networks in close association with the nuclei in cells of the root-tips of Allium, Lilium, and Canna.

It seems that the presence of Golgi bodies in higher fungi (especially Basidiomycetes) has not been reported as yet. For the last eight months I have worked on a number of our common Agarics and Polypores, col-

lected fresh and living, namely, Lentinus subnudus. Lepiota mastordeus, Flammula dilepis, Entoloma microcarpum, Psathyra lucipeta, Panaeolus cyanascens.



. 1 —Golgi apparatus in *Lentinus subnudus*; after fixing for 10 days in potassium bichromate and osmic acid. Camera lucida drawing, under immersion lens, Zeiss apochromat, 2 mm , N. A. 1.4  $\times$  1100

Schizophyllum commune, Polyporus zonalis, Ganoderma lucidum, Lenzites repanda, etc. The basidia of all of them were studied, and for the sake of close parallel comparison each specimen was simultaneously treated in four different ways, namely, (1) by fixing in Fleming's strong fluid mixed with an equal quantity of water, and finally staining the microtome sections (5-6  $\mu$  thick) with Heidenham's iron-hæmatoxylin, (2) by fixing in Bensley's fluid to study the form and the location of the vacuoles; (3) by fixing in Golgi's bichromate and silver nitrate method (rapid process): and (4) by vital staining with a very weak solution of neutral red.

By the silver impregnation method I could get within the basidia of the majority of specimens a clear network of blackened coil, usually corresponding with the position of the vacuoles. In some the black coil was found close to the top of the basidia, in some the coiled threads were at the bottom, and in others they were on the sides almost at the central part of the basidia. In Bensley's fluid the vacuolar system came out prominently as a unit. In Fleming's fluid the details of the nuclei were distinctly seen. Staining with neutral red, the metachromatic bodies within the vacuoles took a deep red stain in the form of droplets; big round drops taking a diffused stain showed in their interior a number of bodies deeply stamed; these vacuoles were found in varying posi-tions within the basidia. By successive trials it has been found that the specimens usually fixed in potassium bichromate and osmic acid from six to ten days shinton Hod formation of the Golgi apparatus. Some of the specimens showed the deposit of the fragments of black threads not yet united into a coil, these are what are known as 'Golgi bodies' as distinct from the 'Golgi apparatus.' Fig. 1 shows the Golgi apparatus in basidia of *Lentinus subnudus*.

I have camera-lucida drawings of a number of basidia from most of the specimens showing the presence of the Golgi apparatus. I hope to publish the details of each specimen in a later paper with the necessary illustrations.

S. R. Bose.

Botanical Laboratory, Carmichael Medical College, Calcutta, Sept. 28.

# Sound Absorption Coefficients measured by Reverberation and Stationary-wave Methods.

There are two methods of measuring the amounts of sound absorbed by various materials. One is the reverberation method of W. C. Sabine, in which a specimen of the material to be tested is mounted on the walls of a reverberation chamber and the coefficient of absorption is deduced from the effect which the presence of the specimen has on the rate of decay of sound in the chamber. The other consists in placing the specimen at the end of a pipe down which sound-waves are made to pass. The reflected and incident waves interfere, and the coefficient of absorption is calculated from observations made on the interference pattern within the pipe.

The advantage of the second method is that only

The advantage of the second method is that only small specimens are needed for a test. Generally a specimen with an area of not more than I square foot is sufficient, whereas for a reverberation test an area of about 100 square feet is needed. It is obvious, however, that the coefficients measured by the two methods will not necessarily have the same value. In the pipe (or 'stationary-wave') method it is the coefficient of absorption at normal incidence which is measured, whereas in a reverberation test (according to current theory) sound impinges on the specimen at all angles of incidence from 0° to 90°

all angles of incidence from  $0^\circ$  to  $90^\circ$ . In a recent paper (*Proc. Roy. Soc.*, A, vol. 115. pp. 407-419, 1927) I have shown how the coefficient of absorption of an 'acoustic plaster' can be calculated for any angle of incidence from the 'acoustical admittance', a quantity which can readily be determined from observations made with stationary-wave apparatus. If  $\Omega_1 + \Omega_2$  is the acoustical admittance per unit area of the absorbing material, and  $\alpha$  is the velocity of sound in air, it is shown that the coefficient of absorption for sound incident at angle  $\theta$  is given by

$$a_{\theta} = 1 - \frac{(\cos\theta - a\Omega_1)^2 + (a\Omega_2)^2}{(\cos\theta + a\Omega_1)^2 + (a\Omega_2)^2}.$$

This expression can be introduced into the theory of reverberation as usually developed (for example by E. Buckingham, Sci. Papers of the Bureau of Standards, No. 506. p. 201), and the 'reverberation' coefficient of absorption, say ... can then be found in terms of acoustical admittance. In this way I find that the reverberation coefficient is given by

$$\begin{split} a &= 8a\Omega_1 \bigg[ \, 1 - a\Omega_1 \log_s \frac{a^2(\Omega_1^{\,\, 2} + \Omega_2^{\,\, 2}) + 2a\Omega_1 + 1}{a^2(\Omega_1^{\,\, 2} + \Omega_2^{\,\, 2})} \\ &\quad + \frac{a^2(\Omega_1^{\,\, 2} + \Omega_2^{\,\, 2})}{a\Omega_1} \, \bigg\{ \tan^{-1} \left( \frac{1 - a\Omega_1}{a\Omega_2} \right) - \tan^{-1} \left( \frac{a\Omega_1}{a\Omega_2} \right) \bigg\} \, \bigg]. \end{split}$$

vol. 115, pp 417-418, 1927). From this we find that the coefficient at normal incidence is  $a_0=0.28$ . This is the coefficient as usually measured by the stationary wave method. From the expression just given it is found that the reverberation coefficient is a=0.45. Hence the reverberation coefficient of the acoustic plaster is much greater than the coefficient at normal incidence. Some support is given to this result by the values of the coefficients for the acoustic tile known as 'Akoustolith.' Stationary-wave measurements at 512 vibrations per second give 0.26 for the absorption at normal incidence (*Proc. Phys. Soc*, vol. 39, p. 281, 1927), while the reverberation absorption coefficient is reputed to be between 0.36 and 0.38. F. R. Watson ("Acoustics of Buildings," p. 25) quotes 0.36. The difference is not so marked as that calculated for the modified Sabine plaster, but it is in the same sense.

The practical importance of establishing a relation between absorption coefficients by the reverberation method and those found with stationary-wave or similar small-scale testing apparatus is obvious, although it appears to have been sometimes overlooked or ignored in the past.

E. T. Paris.

Air Defence Experimental Establishment,

Biggin Hill, Kent, Oct. 25.

#### Flame and Combustion.

If I know not the meaning of the voice, I shall be unto him that speaketh a barbarian and he that speaketh a barbarian unto me.

In my early days, I happened to be present in Vice-Chancellor Bacon's court when a ward in Chancery came up to be spoken with. After a long whispered conversation with her the Vice-Chancellor said to her counsel: "Mr ---, the lady does not know her mind; when she knows her mind, let her again come here and speak with me." The young lady protested indignantly 'that she did know her mind '—but to no purpose. After a few more words with her, the judge repeated what he had said Counsel took the hint and bore the fair protesting one away. Messrs. Bone, Townend and Co (NATURE, Nov. 12, p. 694) are like that lady: they have burst violently into flame without having mastered the very tangled story of the great drama of chemical interchange which 'flame' connotes. Like the modern school boy and college-student, they want teacher to learn them their lessons. I have always been against spoon feeding. Moreover, Prof. Bone is the last person to learn through others. When the firm has full grip of the case, if here, I shall be pleased to speak with them. Thus far but no further does my imagination go at present It is not for me even to help on a decision whether it be safe to accept its guidance at any time.

Prof. Finch seems to have made interesting experiments. He always does and I have the very highest regard for his work. To dissect out the meaning of his observations will not be easy and is not even to be attempted upon such premature partial publication. Still, I may say, that I fail to understand how even that marvellous material 'water' can play an electrical and not a chemical part. I must confess that I am old-fashioned enough—if not medieval—to retain my faith in one Faraday and that I regard the two 'parts' as inseparable and interdependent, perhaps also because I learnt physics and chemistry as one subject in my blameful youth. Here is necessary to think down to the intimate interchange. This no one will do.

Mr. Egerton, too, appears to have made

observations but he also uses language so ambiguous that it is scarcely possible to guess what he means Thus, he concludes that the process of combustion is "autocatalytic." This sounds very learned. The statement must carry profound conviction and endless joy to the 'anti-knock' soul. Yet, what does it mean, how will it help us to make the internal com-bustion engine efficient 'Catalytic' is one of those blessed words which carry no particular meaningthe shibboleth of the day, lisped in every scientific nursery. At least three special perambulators have been chartered to carry the infant catalysis 'hopping' in chemists' gardens. Yet neither the Cambridge nor the Princeton nor the Johns Hopkins nuise can tell us what mission the baby is bawling. I see the note dates from Oxford Looking this up in my Gazetteer, I find: A place where grass grows and dictionaries are made, but the meanings of words are not calculated in use. Then, in the new volume of the "Dictionary of National Biography," I find the statement made of the late Loid Rayleigh: "There still lingers in Cambridge a tradition as to the lucidity and literary finish of his answers in this examination [the Mathematical Tripos]. Every paper he wrote, even on the most abstruse subject, is a model of clearness and simplicity of diction" When we can say this of the papers we write on combustion, perhaps we shall begin at least to know where we are not.

HENRY E. ARMSTRONG.

### Movements of the Lower Jaw of Cattle during Mastication.

Among the biological phenomena exhibiting a definite sense of rotation, as, for example, the growth of certain creepers and of the shells of snails, one that does not seem to have been studied and to which we wish to direct attention here, is the masticating motion Close investigation shows that the lower jaw of the animal is displaced with respect to the upper jaw, not in a purely horizontal or a purely vertical direction, but simultaneously in both directions with such a phase difference that a clearly evident rotation results. Theoretically this can, of course, take place in two senses, and observation teaches that both possibilities are realised in Nature. Taking the direction of the food as positive, we shall denote as right- and left-circular cows those of which the chewing motion, viewed from the front, turns clockwise and counterclockwise respectively.

This nomenclature is based on the tacit assumption that one and the same cow always maintains its sense of rotation. We could confirm this by a limited number of observations but are aware that more complete data, extending over longer periods of time, are necessary definitely to settle this point. Statistical investigations on cows distributed over the northern part of Sjælland, Denmark, led to the result that about fifty-five per cent. were right-circular, the rest leftcircular animals. As one sees, the ratio of the two kinds is approximately unity. The number of observations was, however, scarcely sufficient to make sure if the deviation from unity is real. Naturally these determinations allow no generalisation with regard to cows of different nationality.

The fact that both senses of rotation are realised raises the question if simple laws govern the hereditary transmission of the property referred to. Concerning the snails mentioned above, one knows that Mendel's laws in their simplest form apply, while in most other cases the actual occurrence of only one sense of intation makes such investigations impossible. Parheularly it would be interesting to ascertain which of the two modifications is the dominating one. We are, unfortunately, not in a position to bring evidence on this important point, but believe that those having a more intimate acquaintance with cattle will find it easy to give an answer. P. JORDAN.

R. DE L. KRONIG.

University Institute for Theoretical Physics, Copenhagen.

#### Polarisation Effects in Measuring Electrostatic Fields.

In listening to a lecture by Dr. Aston, in which the mass spectrograph was described, the writer was interested to hear that a polarisation of the plates of the condenser determining the electrostatic deflexion of the positive rays affected the field to such an extent to be one of the causes which made it necessary to necur to relative measurements in interpreting the results. Dr Aston mentioned that the effect could be reduced by gilding the plates.

A few years ago attention had been centred on these polarisation or double layer effects in connexion with X-rays, in discussing the question how far such a layer formed under the influence of the electronic bombardment of the anticathode might affect the velocity of the electrons reaching the target. It is remarkable that they are so prominent in positive ray experiments, where the cathodic bombardment cannot be intense.

In Dr. Aston's determinations the polarisation was a disturbance, which he was able to trace in his results

and to eliminate entirely.

Few physicists are in this fortunate position and to the writer it seems of interest to direct attention to the fact that, so long as no greater knowledge as to the conditions determining the magnitude of these polarisation effects is obtained, they constitute a particular source of error, which is but too easily overlooked in a number of cases where the production of stray rays cannot be eliminated, for example, in the determination of em for the electron according to some classical methods. J. Brentano.

The University. Manchester, Nov 12.

### Biology and Birth-Control.

It would interest me, and possibly some of your readers, if the writer of the review of my "Right of the Unborn Child" in NATURE of Nov 5 would cite the sentences in which, according to him, I make "contemptuous remarks about God." KARL PEARSON.

University College, London, W.C.1.

THE answer to Prof. Pearson's question is that he quoted with approval. as expressive of his meaning, J. C. Squire's lines, including "Good God! said God. 'I've got my task cut out'" This seems to me contemptuous, and even blasphemous. E. W. MACBRIDE.

### The 'Green Flash.'

REFERRING to page 728 of NATURE of Nov. 19, greenish appearances at sunset and sunrise may be due to various causes: but I am personally convinced that the sudden green flash, seen by some people when the last rim of the sun disappears behind a sharp horizon, is mainly physiological; for I see (if it can be called seeing) a momentary greenness when I switch off a bright lamp, with metallic filament, suspended above my bed. OLIVER LODGE.

Normanton House, Lake, Salisbury.

### Alloys and their Importance in Engineering.

IN an interesting and suggestive presidential address delivered to the Institution of Mechanical Engineers on Oct 21, Sir Henry Fowler paid a tribute to the help that mechanical engineering has received, in the solution of many of its most difficult problems, from the work of the man of science. Particularly he attributed the remarkable changes that have taken place since Stephenson built the Rocket to new materials and the physical states in which they can be supplied, and in large measure these have been the outcome of scientific The whole profession of mechanical engineering is to-day dependent on metals. "Although many ingenious contrivances have been made from wood and stone, mechanical engineering only commenced when metals became available for use."

In the middle of the nineteenth century, railways were developing very rapidly and the makers of iron rails could not cope with the demand, but the truly scientific work of Bessemer and his production of steel relieved the situation. Between 1850 and 1926 the world's production of cast iron grew from  $4\frac{1}{2}$  million tons to 77 million tons. In 1870 the total steel produced was less than  $\frac{1}{2}$  million tons; in 1927 more than 90 million tons were made. Only three metals were used for the manufacture of the Rocket; to-day, on the L.M.S. railway, fifty-five specifications for metals are used, and the British Engineering Standards Association has prepared standard specifications for more than 100 varieties of steel. Sir Henry Fowler pointed out that the work of Bessemer and of Siemens and Martin insured for many years a sufficient quantity of steel, but the work of two other men of science, Thomas and Gilchrist, who in 1876 discovered that phosphorus could be very appreciably diminished by using a basic lining in the melting furnace, increased enormously the possible supplies.

The improvement and control of the quality of steels by improved methods of manufacture and the development of new alloy steels for tools and other purposes have revolutionised not only the methods of the machine and fitting shops, but also the designs of all types of machines and structures. The development of photomicrography and the pyrometer have contributed in no small measure to the success that has been achieved. Michael Faraday a century ago in England, and Berthier in France, experimented on alloys of nickel and chromium, but it was not until 1857 that Mushet alloyed tungsten with iron and made self-hardening steel: the remarkable developments in cutting speeds and in automatic machinery, consequent upon the new alloy tool steels, has almost entirely taken place, however, during the last twenty-five In 1882, Hadfield produced the manganese steel, so largely used to-day, because of its hardness, for points and crossings and dredger buckets, and later produced the silicon steel which has had very remarkable effects upon the construction of transformers and other magnetic and electrical apparatus.

During the twentieth century the nickel and nickelchromium steels and the so-called molybdenum and vanadium steels made by the addition of small quantities of these metals to the nickel-chromium steels have not only played a considerable part in the development of the automobile and the aeroplane, but steels have also been produced having remarkable magnetic, or non-magnetic, properties and others which resist both corrosion and high stresses at normal and high temperatures in a remarkable manner. Some of these alloys resist the action of the strongest acids and are proving of the greatest service in the chemical industry. Others are not only valuable for case-hardening boxes and heating pots but also give promise of helping in the solution of difficulties in superheater elements, in the development of high temperature - high pressure vessels for distillation and synthetic processes and the gas turbine.

Turning from steels to the non-ferrous metals, the developments in the copper alloys, bronzes and brasses, and in the aluminium alloys, have been equally remarkable. Muntz metal was the first of the alloys of copper that could be forged and extruded, but it was not until mass production became important that full advantage of this alloy was taken. To-day the British Engineering Standards Association specifications demand for high tensile brass a breaking strength of 45 tons per sq. inch, and for brass bars 28 tons per sq. inch, and an elongation per cent. of 25 per cent. on a gauge length of not less than four diameters.

Alloys of copper—brasses and bronzes—of greater strength than these are possible. In these developments the work of contributors to the reports of Alloys Committee of the Institution of Mechanical Engineers has played an important part.

Aluminium in the commercial form has only been known for thirty-five years. In 1913 the world's production of aluminium was 64,000 tons, but in 1926 this had risen to 235,000 tons. In the pure state it is of comparatively little use to the engineer, but when alloyed with zinc and copper. with copper, manganese, and magnesium (4 per cent. Cu, ½ per cent. Mn, ½ per cent Mg as duralumin), with copper, nickel, and magnesium (4 per cent. Cu, 2 per cent. Ni,  $1\frac{1}{2}$  per cent. Mg as Y alloy), with copper and silicon (a 4 per cent. Cu, 4 per cent. silicon is a good casting alloy for sund or die), and with other metals, a remarkable series of light alloys having specific gravities from 2.8 to 3.1 have been produced alumin can be forged, extruded, and cold drawn, and by suitable heat treatment can be made to give a breaking stress of 32 tons per sq. inch with from 6 to 10 per cent. elongation Y alloy can be hot rolled and heat treated to give 24 tons per sq. inch and 23 per cent. elongation; all the other alloys can be cast into intricate shapes, and some of them make admirable die castings. For many parts of aeroplanes, aeroplane engines,

and automobiles these alloys have proved invaluable. In the I7 ited States of America railway carriage frames? e being constructed of duralumin. thus diminishing the dead weight, as compared with the net weight carried, very considerably Die castings of intricate shapes, such as gear wheels. are now being made, to a remarkable degree of accuracy, of aluminium bronzes-alloys of copper and aluminium, containing more than 80 per cent.

The rapidity with which these alloys have been developed and have won the confidence of engineers is a tribute to the careful scientific work that has been done in connexion with their constitution and physical properties The success achieved by the aluminium alloys has encouraged a number of workers to investigate the possibilities of alloying magnesium, which has only a specific gravity of 1 7 as compared with 2.67 for aluminium, with other metals, and already some success has been achieved in the application of magnesium allovs, containing more than 90 per cent of magnesium, to the manu- he that hath little business shall become wise."

facture of high-speed pistons for internal combustion engines and other purposes

Sir Henry Fowler paid a tribute to the important research work done in the great works, at the National Physical Laboratory and also at the universities, but he emphasised the necessity for researches conducted jointly by men of science and engineers. Unfortunately, he did not suggest any method whereby the ability at present in the universities, which owing to pressure of teaching and other routine duties is not able, except at the cost of health, to apply itself to the solution of many problems with which industry is faced, can be given the necessary time and means to carry out research The only hope seems a more generous provision of funds for the direct assistance of research in the engineering and metallurgical departments of the universities, in order that the condition of the apt quotation with which the address 'The wisdom of the concluded may be fulfilled scribe cometh by the opportunity of leisure and

## Scientific Aspects of Intense Magnetic Fields and High Voltages.<sup>1</sup>

By Sir Ernest Rutherford, O.M., Pres.R.S.

TN the past our laboratories have had to be content with the comparatively weak magnetic fields provided by the ordinary electro-magnets and the voltages supplied by simple electrostatic machines and induction coils. In order to push further our investigations in many directions, much stronger magnetic fields and higher voltages are required in the laboratory Scientific men thus naturally follow with great interest advances in these directions, whether undertaken for purely scientific or for technical uses.

By means of modern electrostatic machines it is not difficult to produce weak direct currents at. potentials from 200,000 to 300,000 volts, while a large well-insulated induction coil can give momentary voltages of a similar magnitude. The wide use of X-rays for diagnostic and therapeutic purposes has led to a marked improvement in apparatus for exciting intense X-rays. The requirement of very penetrating X-rays for deep therapy in our hospitals has led to the construction of comparatively light transformers, which will supply the requisite small currents at voltages between 300.000 and 500,000

One of the simplest ways of producing very high voltages is by the Tesla transformer, in which the oscillatory discharge of a Leyden jar is passed through the primary of an air transformer. In this way it is not difficult to produce voltages in the secondary of the order of a million volts, and I understand as much as five million volts have been obtained in the Carnegie Institution of Washington The striking effects produced by these rapidly oscillating discharges from a Tesla coil, and the immunity with which long sparks may be taken through the body, are well known to all. rapid frequency of the oscillations and the compara-

 $^{\rm 1}$  From the presidential address delivered at the anniversary meeting of the Royal Society on Nov. 30.

tively small energy given to the secondary of a Tesla coil has, however, restricted its use for general technical purposes as a source of high voltages, although it is now finding an application for the testing of insulating materials.

In order to transmit electrical power economically over long distances, there is a continuous tendency to raise the voltage in the transmission This increase of the operating voltage has led to the need of very high voltages to test the insulating properties of these lines and their transformers and the effect of electric surges in them In the course of the last few years a number of high-voltage plants have been installed for testing purposes in various countries, which give from one to two million volts. These voltages may be obtained either by a very large well-insulated power transformer or more generally by a cascade method employing several transformers in which the secondary current of one transformer passes through the primary of a second, and so on, the cores of the successive transformers being mounted on insulating pedestals. This cascade method is very advantageous for the purpose, since it allows a great reduction in weight and dimensions of the transformers. Such a high-tension plant in full operation is a striking sight, giving a torrent of sparks several yards in length and resembling a rapid succession of lightning flashes on a small scale. Actually the highest voltage so far obtained by these methods is very small compared with the voltage in a normal lightning flash from a cloud to the earth, where the difference of potential may be as high as a thousand million volts.

There appears to be no obvious limit to the voltages obtainable by the cascade arrangement of transformers, except that of expense and the size of the building required to install them. I am informed that the General Electric Company of Schenectady has a working plant giving 2,800,000 volts (max ), and hopes soon to have ready a plant

to give 6 million volts

While no doubt the development of such high voltages serves a useful technical purpose, from the purely scientific point of view interest is mainly centred on the application of these high potentials to vacuum tubes in order to obtain a copious supply of high-speed electrons and high-speed atoms. So far, we have not yet succeeded in approaching. much less surpassing, the success of the radioactive elements, in providing us with high-speed  $\alpha$ -particles and swift electrons. The  $\alpha$ -particle from radium Cis liberated with an energy of 7.6 million electron volts, that is, it has the energy acquired by an electron in a vacuum which has fallen through this difference of potential. The swiftest  $\beta$ -rays from radium have an energy of about 3 million electron volts, while a voltage of more than 2 million would be required to produce X-rays of the penetrating power of the y-rays

The application of high voltages to vacuum tubes presents serious technical problems, but a vigorous attack on this side of the question has been recently undertaken by Dr. Coolidge. In 1894, Lenard made the discovery that high-speed cathode rays generated in a discharge tube could be transmitted into the open air through a very thin window, and made very important observations on the laws of absorption of these swift particles The voltage used to accelerate the electrons in these experiments seldom exceeded 80,000 volts and the ravs were stopped in passing through a few inches of air. Taking advantage of the great improvements in vacuum technique and the ease of supply of electrons from a glowing filament, Dr Coolidge has constructed an electron tube which will stand 300,000 volts, the rays passing into the air through a thin plate of chrome-nickel-iron alloy about

0.0005 inch thick.

It has not so far been found practicable to apply much more than 300,000 volts to a single tube, on account of the danger of a flash over, due possibly to the pulling-out of electrons from the cathode by the intense electric field. For the application of still higher voltages, a number of tubes are arranged in series and communicating with one another, the fall of potential in each being about 300,000 volts. In these preliminary experiments, a large induction coil has been used to generate the voltage. So far, experiments have been made with three tubes in series and 900,000 volts, giving a supply of electrons corresponding to one or two milliamperes through the thin window in the last tube. This gives an intense beam of high-velocity electrons, which spreads out into a hemisphere, due to the scattering of the electrons in passing through the metal window and the surrounding air, extending to a distance of about two metres from the window. Marked luminous effects are produced in the air itself and in phosphorescent bodies placed in the path of the rays. I am informed by Dr. Coolidge that further experiments are in progress, and it is hoped to extend the system for still higher voltages.

While the energy acquired by the individual electrons in falling through 900,000 volts is smaller than that possessed by the swifter  $\beta$ -particles expelled from radium, the number emitted from the electron tube is very much greater; for example, the number of electrons per second corresponding to a current of 2 milliamperes is equivalent to the number of  $\beta$ -rays emitted per second from about 150,000 gm. of radium in equilibrium.

While important progress has been made in artificially producing streams of swift electrons, there is still much work to be done before we can hope to produce streams of atoms and electrons of a much higher individual energy than the aor  $\beta$ -particle spontaneously liberated from radio-As we have seen, the  $\alpha$ -particle from radium C is initially expelled with an energy of about 8 million electron volts So far, the a-particle has the greatest individual energy of any particle known to science, and for this reason it has been invaluable in exploring the inner structure of the atom and giving us important data on the magnitude of the deflecting field in the neighbourhood of atomic nuclei and of the dimensions of the nuclei In case of some of the lighter atoms, the a-particle has sufficient energy to penetrate deeply into the nucleus and to cause its disintegration, manifested by the liberation of swift protons.

It would be of great scientific interest if it were possible in laboratory experiments to have a supply of electrons and atoms of matter in general, of which the individual energy of motion is greater even than that of the a-particle. This would open up an extraordinarily interesting field of investigation which could not fail to give us information of great value, not only on the constitution and stability of atomic nuclei but also in many other

directions

It has long been my ambition to have available for study a copious supply of atoms and electrons which have an individual energy far transcending that of the a- and  $\beta$ -particles from radioactive bodies. I am hopeful that I may yet have my wish fulfilled, but it is obvious that many experimental difficulties will have to be surmounted before this can be realised, even on a laboratory scale.

We shall now consider briefly the present situation with regard to the production of intense magnetic fields. Electro-magnets are ordinarily employed for this purpose, and the magnetic fields obtainable are in the main limited by the magnetic saturation of the iron. By the use of large electromagnets and conical pole pieces, the magnetic induction can be concentrated to some extent. For example, in the large Weiss electro-magnet, a field of 80,000 gauss can be obtained over a volume corresponding to about a pm's head, and a field of about 50,000 gauss through a volume of about 20 cubic mm In general, however, most experiments have been restricted to fields less than 35.000 gauss.

In order to push this method of obtaining

magnetic fields to the practical limit, Prof Cotton, of Paris, has designed and has under construction a very large electro-magnet The cross-section of the iron will be of the order of one square metre, and about 500 kilowatts will be required to excite it. Such a large electro-magnet will not give a much stronger maximum field than existing ones, but will produce a field of given intensity through a larger volume No doubt this electro-magnet will prove very useful in experiments where steady fields of high intensity are required through a reasonable volume.

In order to provide magnetic fields of the order of half a million gauss, the use of the electro-magnet must be abandoned Some years ago, Dr Kapitza suggested that intense momentary magnetic fields could be obtained by sending a very strong current through a coil for such a short interval that the heating effect in the coil is restricted to a permissible value It is well known that momentary currents of great intensity can be produced by the discharge of a large high-voltage condenser through Experiments of this kind have been made by Dr Wall, in which the duration of the discharge was of the order of one-thousandth of a second. It is estimated that in this way a field of about 200,000 gauss may be reached.

In his experiments to obtain intense magnetic fields, Dr. Kapitza at first employed a special form of accumulator to send a very strong current through a coil for about one-hundredth of a second, the current if necessary being sharply broken after this interval. In this way it was shown to be practicable to carry out experiments on the Zeeman effect, and in bending  $\alpha$ -particles in magnetic fields considerably stronger than those obtainable with ordinary methods. In subsequent experiments, a generator of special design was installed, which gives a very large current, of the order of 70,000 amp, at 2000 volts when short-circuited. A heavy current from the generator is passed for about one-hundredth of a second through a coil and then sharply broken by means of a specially designed automatic break By this means very strong momentary currents can be produced

The main difficulty in these experiments has been to construct a coil strong enough to withstand the enormous disrupting forces which arise when a large current is passed through the coil. By special attention to the design, a coil has been made which gives

a field of 320,000 gauss over a volume of about 3 c c. without any signs of fracture Measurements have been regularly carried out in fields of this magnitude. It is anticipated that the present design of coil will give about 500,000 gauss before bursting, and that still higher fields can be obtained in coils specially constructed for the purpose.

As the current only lasts about one-hundredth of a second, oscillograph methods have to be employed to determine the strength of the current and magnetic field 
There seems to be no inherent difficulty in conducting magnetic experiments in these momentary fields, for the shortness of the time available is in many cases compensated for by the magnitude of the effects which arise in such intense fields. The investigations, which have been carried out in the Cavendish Laboratory, have been made possible by the generous support of the Department of Scientific and Industrial Research, which has defrayed the cost of the apparatus and experiments

The application of these new methods of producing intense fields opens up a wide region of research, where all magnetic properties can be examined in fields ten to twenty times stronger than those hitherto available. Such researches cannot fail to yield results of great interest and importance and to advance our knowledge of

magnetic phenomena.

While the application of external magnetic fields of the order of one-million gauss will no doubt markedly perturb the orbits of electrons in the outer structure of the atom, it is not to be anticipated that they will seriously affect the stability of atomic nuclei. General evidence indicates that the magnetic fields within the nucleus are much too great for such a relatively weak external field to cause a disruption of the nucleus. In this direction, the bombardment by high-speed particles is likely to be far more effective than the strongest magnetic field we can hope to generate.

This advance of science depends to a large extent on the development of new technical methods and their application to scientific problems. The recent work to which I have referred, on the development of methods of producing high voltages and intense magnetic fields, is not only of great interest to scientific men in itself but also promises to provide us with more powerful methods of attack on a

number of fundamental problems.

#### News and Views.

In February 1925 the residuary trust funds of the estate of the late Dr. Conway Evans, medical officer for the Strand district, who died in 1892, were transferred to the president of the Royal Society and the president of the Royal College of Physicians of London, and their successors in office, that in accordance with the terms of his bequest they "shall apply the same in giving rewards to such person or persons who, in the opinion of the Presidents, have rendered, or shall from time to time render, some valuable contribution or addition to science as it exists at the time of my death, either by invention, discovery, or otherwise" In accordance with this trust, the president of the Royal Society and the president of the Royal College of Physicians of London have made the first award of the Conway Evans Prize, amounting to 500 guineas, to Sir Charles Sherrington, on the ground that his work on the physiology of the nervous system, and chiefly on the physiology of the brain and spinal cord of the higher animals, has brought many complex nervous functions for the first time within the range of investigation and analysis. His discoveries have had a profound influence throughout the world on the experimental sciences of physiology and psychology and have thrown a flood of new light on many of the symptoms of nervous disease. In making this first award for some valuable contribution to science as it existed at the time of the death of the testator, the presidents of the Royal Society and of the Royal College of Physicians state that they have had no hesitation in selecting as conspicuously worthy of such recognition the work of Sir Charles Sherrington, which they believe to be of outstanding value for science and for humanity.

The twenty-fifth annual report of the Imperial Cancer Research Fund gives an account of another year of steady progress without any sensational discoveries. The interesting facts about multiple tumours receive special attention. Two independent cancers in the same person are very uncommon, and it has been found impossible to produce tar-cancer in mice after removal of a spontaneous mammary cancer or of an experimental cancer One malignant tumour evidently causes the body to do something which to some extent protects it against another tumour. The nature of this mechanism is under investigation: it nught well be the explanation of some of the vagaries of the occurrence of cancer in man. As in most cancer research institutes, the hypothesis of Gye and Barnard is under intensive examination. confirmatory results have been obtained, but there is as yet no unanimity about the facts or their interpretation. The financial position of the Fund is fairly satisfactory, but an uncomfortably large proportion of the income comes from temporary and casual sources.

WE learn from the Annual Report of the British Photographic Research Association that the Department of Scientific and Industrial Research has offered to the Association a block grant for the five years ending May 31, 1932, that will make up the income of the Association from other sources (its members' subscriptions) to £5000 per annum. There are certain conditions, and the one that is essentially new requires the appointment of a "Research Committee of technical and scientific persons in whom shall be vested the supervision of the scientific investigations of the Association." It is very satisfactory to know that, although the income of the Association will probably be rather less than it has been, the useful work that it has been carrying on for the last ten years will be continued. The Report gives the details of the last year's work, and states that investigations into the fundamental properties of the silver halides are being continued in order to ascertain whether the mechanism of the latent image formation can be connected directly with some purely physical property which can be studied in the absence of such complicating factors as gelatin.

The kinematograph film is being increasingly used for educational purposes, and we note with interest that two films dealing with disease-carrying insects have recently been produced by the National Department of Health of Argentina, one on the house-fly and its relation to disease, and the other on mosquitoes and malaria. Both films were prepared at Buenos Aires under the direction of Dr. Barbará, of the

Bacteriological Institute, but though primarily intended for propaganda purposes in Latin America, they could readily be adapted for instructional courses in medical entomology elsewhere; we believe copies can be obtained on loan. The house-fly film is particularly good, and includes photographic records from Nature of the complete life-history of the fly; habits of adults, oviposition (the actual deposition of an egg is shown), egg-hatching, larval growth and movements, pupation and hatching of adults The characteristics of various Muscidæ are shown, and there are some remarkable photographs of the development of bacteria and the life-history of trypanosomes. mosquito film is not quite so full, and the producers have made greater use of drawings and diagrams, but the life-history of culicine mosquitoes is well shown, also various control methods, and the development of malarial parasites, besides symptoms and treatment of the disease

THE following appointments have been made by the principal trustees of the British Museum · Mr. R. A. Smith, to be Keeper of British and Medieval Antiquities, in succession to Mr O. M. Dalton, who retires in December, Mr. E. J. Forsdyke, to be a Deputy Keeper in the Departments of Antiquities, in succession to Mr. R. A. Smith; Mr. H I. Bell. to be a Deputy Keeper in the Department of Manuscripts, in succession to Mr. J. A. Herbert, who has just retired. The principal trustees have also made the following appointments in the Natural History Museum: Dr. L. J. Spencer, to be Keeper of Mineralogy, in succession to Dr G. T. Prior, who retires on Dec. 16; Dr. W. D. Lang, to be Keeper of Geology, in succession to Dr F. A. Bather, who retires next February. Mr. J. Ramsbottom, to be a Deputy Keeper in the Department of Botany, on the promotion of Dr. Spencer; Mr. M. A. C. Hinton, to be a Deputy Keeper in the Department of Zoology, on the promotion of Dr. Lang.

In February next, after forty years' service in the British Museum (Natural History), Dr F. A. Bather retires from the post of Keeper of the Department of Geology. His vigorous and cheery personality will be missed by geologists visiting the Museum no less than by his colleagues. Educated at Winchester and Oxford, he joined the staff of the British Museum in 1887 as assistant in the Department of Geology, and was placed in charge of the Echinoderma. After becoming assistant keeper, and later deputy keeper, he succeeded Sir Arthur Smith Woodward as Keeper of the Department in 1924 Dr Bather was elected F.R.S. m 1909; was awarded the Lyell Medal by the Geological Society in 1911; has been president of Section C of the British Association, and of the Museums Association; he is now president of the Geological Society. Dr. Bather's original work on the palæontology of the echinoderms has gained him a world-wide reputation, and amongst the distinguished palæontologists of to-day he stands in the front rank. His memoirs and papers are too well known to need mention here; not only are they models of scientific method, but also they possess a literary charm seldom found in the writings of scientific authors.

In his presidential addresses to Section C of the British Association at Cardiff (1920), and to the i in the British Museum (Natural History), who retires Geological Society last February, Dr. Bather dealt in a masterly manner with the principles of palæontology, and his listeners felt that those addresses were worthy of Huxley. Dr. Bather does more than look on fossils from the point of view of a morphologist and evolutionist; as is so well shown in his "Caradocian Cystidea of Girvan," he regards them as animals which once lived, and endeavours to correlate form with function, morphology with physiology. For several years Dr. Bather contributed the section on Echinoderma to the Zoological Record; although these are masterpieces of bibliography and analysis, one cannot avoid a feeling of regret that so much of his time was taken away from original research. In another direction, by the active interest which he has taken in the work of the Museums Association. Dr. Bather has rendered good service to his country; he has contributed many papers to the Association's journal dealing with the preparation and exhibition of specimens and other matters of importance to the curators of provincial museums. After his release from the cares and responsibilities of office, all who know Dr. Bather, whether personally or only from his writings, will fervently hope that leisure and health will enable him to continue for many years his splendid work in palæontology.

Dr. W. D. Lang, who has been appointed Keeper of the Department of Geology in the British Museum in succession to Dr. F. A. Bather, was educated at Harrow and at Pembroke College, Cambridge. He graduated in 1901, and obtained the degree of Sc.D. in 1919. Dr. Lang became an assistant in the Department of Geology in 1902, and was placed in charge of the lower groups of mvertebrates; he became assistant-keeper in 1924, and afterwards deputykeeper in the Department. His palæontological work deals mainly with corals and Polyzoa, treated from an evolutionary viewpoint-his conclusions concerning genetic relationship being based on ontogeny and zonal succession as well as on morphological characters. Of his numerous memoirs on these groups of fossils, we can only mention "Growth-stages in Parasmilia" (1909), "The Pelmatoporinæ, an essay in the evolution of a group of Cretaceous Polyzoa" (1919), and "Catalogue of the Fossil Bryozoa (Polyzoa) in the British Museum: Cretaceous" (1921, 1922). In a series of papers in the Proceedings of the Geologists' Association, Dr. Lang has done yeoman service for students by his lucid exposition of some of the general principles of palæontology; of these papers we may name "Old Age and Extinction in Fossils," "Homeomorphy in Fossil Corals," "Trends in Carboniferous Corals." Dr. Lang has not confined himself to work in the Museum, but for many years has devoted his vacations to the investigation of the faunal succession of the Lias of the Dorset coast; the last of his numerous papers on this subject was read before the Geological Society on Nov. 16. We feel confident that Dr. Lang will worthily maintain the high standard set by his two predecessors in the Department of Geology.

on Dec. 16 at the age of sixty-five years, entered the museum in 1887 to fill the vacancy caused by the death of Walter Flight, who had done the greater part of the chemical work of the department Dr. Prior was well qualified for this work. He had obtained a demyship in natural science at Magdalen College, Oxford, in 1881, and gained a first class in the honours schools of natural science in both chemistry (1885) and physics (1886), and had also studied for a short time in Germany. His papers on chemical mineralogy dealt with many minerals presenting interesting problems for the analyst, such as the niobates and tantalates of the rare earths, the cerargyrite group, and some of the sulpharsenites and sulphantimonites of copper and silver. About 1893 he undertook the care of the rock collections in the department in addition to his chemical work, since when he has published many petrographical papers of which the most important are his account of the volcanic rocks of British East Africa and the report on the rock specimens collected by Scott's (Discovery) Antarctic Expedition of 1901-4 On the appointment of Sir Lazarus Fletcher as Director of the Natural History Museum in 1909, Dr. Prior was made Keeper of Minerals. He then turned his attention to the meteorite collection, and here he found ample scope for careful critical chemical investigation, which led to the publication of numerous descriptions of meteorites and two papers of particular interest giving his views on their genetic relationships and classification. In addition he has written a "Catalogue of Meteorites," giving a full account of the falls represented in the museum collection. He was elected a fellow of the Royal Society in 1912, and was awarded the Murchison Medal of the Geological Society in 1927. He is now president of the Mineralogical Society, of which he had been the secretary since 1909.

DR. GEORGE THURLAND PRIOR, Keeper of Minerals

Dr. Leonard James Spencer, who succeeds Dr. G. T. Prior, entered the Department of Minerals in 1894. He was then twenty-four years of age, and had studied at Bradford Technical College, at the Royal College of Science in Dublin, and at Cambridge, where he was a scholar of Sidney Sussex College. He gained a first class in Part 2 of the Natural Sciences Tripos in 1893, taking geology, for which he was awarded the Harkness Scholarship. Before taking up his duties at the museum he studied for a short time under Prof. Groth in Munich. He has published a great number of papers on descriptive mineralogy, including accounts of the new minerals miersite, parahopeite, tarbuttite, chloroxiphite, and diaboleite. He translated Max Bauer's "Precious Stones" in 1904 and R. Braun's "Mineral Kingdom" in 1908-12, wrote "The World's Minerals" in 1911, and has contributed numerous articles on crystallography and mineralogy to Thorpes' "Dictionary of Applied Chemistry," and to the "Encyclopædia Britannica." But it is as an abstractor, editor, and indexer of mineralogical papers that Dr. Spencer has rendered especially useful service to the science. Since 1895 he has written abstracts for the Chemical Society. From 1900 until 1914 he was referee for the immeralogy volumes of the 'Catalogue of Scientific Literature' He undertook the editing of the Mineralogical Magazine in 1901, became collaborator for mineralogy and crystallography in the International "Tables annuelles de constantes et données numeriques" in 1912, and commenced the publication of Mineralogical Abstracts in 1920, the majority of the abstracts for which have been written by himself. For his earlier work he was awarded the Wollaston Fund of the Geological Society in 1902. He was elected a fellow of the Royal Society in 1925.

PROF. W. A. BONE, lecturing before the Chemical Society on Nov. 24, took as his subject "Gaseous Combustion at High Pressures" Since 1920, Prof. Bone and his junior colleagues at the Imperial College of Science and Technology have been engaged in the study of the combustion of mixtures of hydrogen, carbon monoxide. or methane with oxygen and diluent gases under considerable initial pressures; as was recently announced in NATURE, this work is shortly to be extended and amplified. Prof. Bone commenced his discourse by emphasising the actual abnormality of the conditions which man is in the habit of regarding as normal, and quoted Prof. Eddington's statement that, apart from the interstellar cloud which is at the moderate temperature of 15,000°, probably ninetenths of the matter of the universe is above 1,000,000°. "We must," he said, "keep our minds open to the reception of knowledge accruing from a study of gaseous interactions under what until recently would have been considered abnormal conditions of density and pressure." Had the pressure of our atmosphere been several hundred times what it actually is, the story of chemistry would have been rather different. The value of high pressure work hes in the fact that it accentuates the operation of influences which are either masked or overlooked at the ordinary pressure. There is a great increase in the rate of chemical change, and a proportionate decrease in cooling and dissociation effects; moreover, the increase in density of the medium may affect both the emission and the absorption of radiation during the explosion.

Bombs and other apparatus now in use at the Imperial College were described and illustrated by Prof. Bone in his lecture referred to above; the spherical bombs are capable of withstanding explosion pressures up to 2000 atm., and a cylindrical one withstands explosion pressures of 1200 atm. The latter can be fitted with quartz windows for spectrographic work, and may then be used up to 500 atm. The behaviour of theoretical hydrogen-air and carbon monoxideair mixtures is in striking contrast; the pressure in the former rises in about 0 005 sec. to 400 atm. (max ), then immediately beginning to fall, whereas in the latter the pressure takes 0 18 sec. to reach 410 atm. (max.), and begins to fall only after a considerable interval. The replacement by hydrogen of a very small proportion of the carbon monoxide enormously accelerates the pressure rise in explosions in gases initially at 50 atm. Prof. Bone also described experiments leading to the recognition of the phenomenon of nitrogen 'activation,' and dealt with the consequent

secondary production of nitric oxide in the presence of excess oxygen. The spectrographic evidence shows that steam does not function chemically, but that carbon monoxide reacts directly with oxygen in carbon monoxide-air explosions, that the radiation emitted in such direct interactions is strongly absorbed by either carbon monoxide or nitrogen, and that in a carbon monoxide-air (excess) explosion at 25 atm. initial pressure, no nitric oxide is formed during the actual explosion period, although more than 25 per cent of nitrogen dioxide may be found in the cooled final explosion products. Prof. Bone paid tribute to the devotion and skill of his junior colleagues, the late Mr W A. Haward, and Drs. D. M. Newitt and D. T. A. Townend.

At the water engineers' congress on Nov. 17, in connexion with the Public Works, Roads and Transport Exhibition at the Royal Agricultural Hall, Islington, Prof. J. W. Gregory gave a lecture upon water divining. He defined the geological problemas being why a method once used in the search for so many objects is now practically restricted to that for water, for which it is perhaps now more used than at any previous time. He explained this as due to shallow water being so widely distributed that the diviner is bound to have a large percentage of successes, while the failures are forgotten. In many cases there is no clue to such water, and the search for it must be often 'wild-catting'; men expert in the search for such water may be often particularly successful. There are three rival explanations—that the rod moves in response to a physical force, to clarvoyance, or to muscular response to the recognition, often perhaps unconsciously, by the diviner of faint clues to water. Prof. Gregory considers that the decision between these views must depend upon the evidence He discussed the chief British evidence and claimed that all the controlled experiments are against the divining rod. He referred especially to those organised by the Sanitary Record and Municipal Engineering at Guildford in 1913, to the tests by Prof. Wertheimer and Prof. Sollas, and to that for oil divining under the supervision of Sir John Cadman at the Anglo-Peisian Company's experimental station Four cases put forward as most convincing evidence for the divining rod by Barrett and Besterman were also discussed, but Prof. Gregory claims that they give no support to either the physical or clairvoyant explanation of the divining rod

"The Nile and the Use of its Waters" was the subject taken by Sir Murdoch Macdonald for his recent presidential address to the Junior Institution of Engineers. Sir Murdoch described the possibilities of land reclamation and irrigation improvements which still exist in Egypt, and explained the constructional works at present under consideration. One proposal, he said, is to heighten the Aswan dam by seven metres, and, so far as stability is concerned, it would be perfectly safe. The Gebel Aulia site for a new dam and reservoir in the White Nile just beyond Khartum is an excellent position, and a relatively low dam built on the sandstone formation would be capable of keeping in a large volume of water. Other suggested

sites for dams are at Lake Tsana and Lake Albert-To meet all the demands of Upper and Lower Egypt for reclamation and irrigation, the summer supply of the river must be increased to about 1500 tons per second, with correspondingly greater volumes during the other periods of the year. Account must also be taken of developments in the Sudan, but the Sudan area is too restricted to take such a quantity of water from the Blue Nile as would harm Egypt. Sir Murdoch said that there is conjoined with all these works, and others which may yet be suggested, a political aspect, but if the builders of all or any of them do not forget the rule that the right of first user to water can not be taken away, that it is a right which can not be separated from the property to which it applies, then justice would be done in the distribution of water to all the inhabitants of the Nile Valley, and the immemorial position in this respect of Egypt in the lower part of that valley would be fully conserved

SIR J. C. W. REITH writes an interesting article on the connexion between the State, the people, and broadcasting, in the Nineteenth Century for November. He points out that we are accustomed to associate controversy with heated crowds, exaggeration, misrepresentation, and general unreasonableness. We think of broadcast politics as differing only in degree and not in kind from platform politics. This, however, is not the case. From the programme department's point of view, politics of the platform type would be quite unsuitable Statesmen will find it necessary to develop a new technique of political argument. This technique will develop as the years go by, but it may be said in advance that it will derive little from classical or even from parliamentary oratory, and nothing at all from the pulpit or the · soap-box. We cannot say how far it will dare to go into a detailed exposition of facts and figures. It is idle to speculate, for the capacity of broadcasting audiences is always developing, and the type of matter acclaimed yesterday is barely conceivable to-day. The possibility of harm can only be prevented by securing a high and conscientious type of man or woman for the profession; one independent alike of the frown of the threatening tyrant and the ardour of the citizens bidding evil The essential qualification is implicit in the conception of service. The word 'fairness,' with all its unspoken connotations, may be taken as representing it in this particular sphere of action.

The publication last week of Sir Baldwin Spencer's work on the Arunta coincided, appropriately enough, with the announcement that he had been awarded the Rivers' Memorial Medal for 1927 by the Council of the Royal Anthropological Institute. This medal, which was founded in memory of the distinguished president of the Institute whose death took place while he was still in office, is awarded for work of pre-eminent merit in the field; in the case of Sir Baldwin Spencer, for the epoch-making work which he carried out in collaboration with the late Mr. F. J. Gillen among the native tribes of Central and Northern Australia.

THE Hopkins Prize of the Cambridge Philosophical Society has been awarded as follows: For the period 1912–15, to Prof. R. A. Sampson, Astronomer Royal for Scotland, for his researches on the internal constitution of the sun, on optical systems, on Jupiter's satellites, and on practical chronometry, for the period 1915–18, to Sir Frank Dyson, Astronomer Royal, for his contributions to the general progress of astronomy, and to the spectroscopy of the solar atmosphere: for the period 1918–21, to Prof. A S Eddington, Plumian professor of astronomy and experimental philosophy in the University of Cambridge, for his work on the classification of the motions of the stars, and on their structure, and on the influence of gravitation on rays of light: for the period 1921–24, to Di J H. Jeans, secretary of the Royal Society, for his work on the theory of gases, and on radiation, and on the evolution of stellar systems

On Dec. 7, Prof. Louis Dollo, Honorary Conservator at the Royal Museum of Natural History at Brussels. will attain the age of seventy years. On that day there will be presented to him a commemorative volume containing articles by fifty-five biologists, as an appreciation of his work in extending to fossils the laws that govern all forms of life. The British contributors to the book are the late William Bateson, F. A. Bather, W. T. Calman, C. Forster Cooper, H. Gadow, E. S. Goodrich, J. P. Hill, J. E. Marr, W. D. Matthew, G. E. Pilgrim, C. T. Regan, A. C. Seward, W. J. Sollas, J. Stanley Gardiner, and A. Smith Woodward. The volume will be the first of a new serial, Paloxobiologica, edited by Prof. O. Abel and published by E. Haim in Vienna.

The annual general meeting of the Decimal Association will be held at the Institution of Electrical Engineers on Tuesday next, Dec. 6, at 5 P.M. and will be open to anyone interested in promoting the adoption of the metric system of weights and measures—the international language of quantity—and decimal coinage into Great Britain. Addresses will be given by Sir Richard Gregory, the retiring president, and by Sir Hugo Hirst, who is succeeding him in that office

REFERRING to the paragraph in Nature of Nov. 19, p. 740, on the proposed Institute of Indexing, we are asked to state that the primary object of Mr. W. R. Douglas Shaw's proposal to establish such an Institute is to improve the standard of book indexes. The proposal provides for the compilation of indexes by the Institute which, however, would neither be conducted for profit nor as a trade union, but as an international fellowship of those interested in the use or production of books and indexing facilities.

In our issue of Nov. 5. p. 648, we published a review of Vol 1 of Dr. George Sarton's "Introduction to the History of Science," at the head of which appeared the names of the American publishers. We are now informed that Messrs. Ballière, Tindall, and Cox, 8 Henrietta Street, London, W.C.2, are publishing this work in the British Empire at 45s

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A temporary assistant on the scientific staff of the *Discovery* Expedition to undertake the preliminary sorting of the zoological collections—The Secretary, *Discovery* Committee, Colonial Office, Whitehall, S.W.1 (Dec. 9).

A lecturer in physics in the Egyptian University, Cairo—The Dean of the Faculty of Science, Egyptian University, Cairo (Dec. 9). An assistant in the botany department of the West of Scotland Agricultural College - The Secretary. West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (Dec. 12). A controller of technical education under the Egyptian Ministry of Education-The Director, Egyptian Educational Office, 39 Victoria Street, S.W I (Dec. 14). A Government analyst and bacteriologist. Cyprus-The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Dec. 15). A professor of economics (including economic history and statistics) in the University of the Witwatersrand, Johannesburg-The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W C 2 (Dec. 31). Eight appointments to the Forest Service of Burma—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (April 7) Two first-class honours graduates for research in optics and allied studies, and in vacuum

physics, in the Research Laboratories of the General Electric Co., Ltd.—The Director, Research Laboratories, General Electric Co, Ltd, Wembley. A fulltime teacher of rubber technology at the Northern Polytechnic, Holloway—The Clerk, Northern Polytechnic, Holloway, N 7 A full-time teacher of engineering subjects and metal work at the Doncaster Technical College—The Principal, Technical College Doncaster. A lecturer in tropical sanitation and hygiene at the Liverpool School of Tropical Medicine—The Hon. Dean, School of Tropical Medicine, Pembroke Place, Liverpool. A young graduate with good general chemical and physical knowledge, preferably with some experience of the technique of colour and colour lake manufacture-The Director, Research Association of British Paint, Colour, and Varnish Manufacturers, Waldegrave Road, Tedding-

Erratum.—In Nature of Nov. 26, p. 770, col. 2, line 9. for "0 137 $d^2$ " read "0 137 $d^3$ ." The equation should thus read.  $\theta = \sqrt{6(d+0.3d^2+0.137d^3+...)}$ .

### Our Astronomical Column.

The Total Lunar Eclipse of Dec. 8.—No total lunar eclipse at a sufficient altitude for refined work is visible in England between the years 1920 and 1938. We therefore have to make the most of those that are somewhat unfavourable. The first contact of the moon with the umbra on Dec. 8 occurs at 3.52 p.m., with the moon on the horizon; totality begins at 4.54 and ends at 6.15, the moon's altitudes, as seen from London, being 9° and 21° respectively; the last contact with umbra is at 7.18; penumbral eclipse continues for another hour, but for the latter portion of it the dimming of the moon's light is too slight to be discernible.

There are two classes of observations that can be usefully made during total lunar eclipses. The first is examination of the amount of light on the eclipsed disc, and its variation in different regions. It is only the lower regions of the earth's atmosphere that have sufficient refractive power to bend the sunlight into the inner part of the shadow; these regions are liable to have their transparency affected by cloud, so that observation of the eclipsed moon gives an integrated measure of the clearness of the earth's atmosphere round the great circle that has the moon in the horizon at the time of observation. Some have tried to establish a correlation between the illumination of the eclipsed moon and the sunspot cycle, and there are advantages in considering an integrated atmospheric effect of this kind rather than the records of isolated stations.

The other useful observations to make during lunar eclipses are occultations of faint stars; the best values of the moon's semidiameter were derived from such observations. During the coming eclipse,  $\iota$  Tauri, mag. 4·7. will disappear at 4.30 P.M., P.A. 84°, and reappear at 5.19, P.A. 245°; B D. 21° 754, mag. 8·2, will disappear at 4.57, P.A. 90°, and reappear at 5.46, P.A. 238°. The latter is taken from the B.4.A. Handbook. The times are for London. The darkness of totality can also be utilised for observing comets, which are usually lost for several days about full moon.

COMETS.—The comet Schwassmann-Wachmann has now been photographed on three days at Bergedorf,

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the following positions having been telegraphed from the I.A.U. Bureau, Copenhagen:

From these, Mr. J. Moller, of Copenhagen Observatory, has computed the following parabolic orbit:

This orbit implies that the comet passed perihelion, 18 months before discovery, and is now outside the orbit of Jupiter. It would have been near opposition at the time of perihelion, and very much brighter than it is now.

It must be borne in mind that the preliminary orbit of such a distant comet is subject to considerable uncertainty. Thus, in the case of comet Shajin-Comas Sola in 1925, the early elements differed much from the final ones. The following ephemeris, calculated from the above elements, is not likely to be much in error:

0h.	RA.	N Decl	log 🕹
Nov. 30	$1^{\rm h} 27^{\rm m} 54^{\rm s}$	20° 18′	$0.72\overline{1}1$
Dec. 8	$1 \ 26 \ 22$	20 0	0.7331
16	$1 \ 25 \ 32$	19 46	0.7457
24	1 25 25	19 34	0.7587
	1 20 20	10 04	0.4004

The Bulletin of Tokyo Observatory gives the following orbit of an object discovered there last January (designated Tokyo 1) which seems from its movement to be a comet, though its aspect was planetary.

The perihelion distance is 1.20 units, the aphelion is near the orbit of Uranus. From the moderate inclination, the object would be hable to make close approaches to Jupiter.

### Research Items.

Polynesian Religion —In Bulletin 34 of the Bernice P. Bishop Museum of Honolulu, Mr E S. Craighill Handy has published an extensive study of the essential elements of the belief and practice characteristic of the ancient worship of Polynesian peoples, the result partly of three years literary research, partly of five years personal investigation in the different island groups of Polynesia. On analysis it appears that the religions of the various island groups at the time of their discovery were of a composite An ancient foundational system is fundamentally related to the culture as a whole, and is most pronounced in the large island groups on the periphery. Hawan, the Marquesas, and New Zealand. It is termed Indo-Polynesian because the sources are to be found in regions long dominated by Indian religious influence. Second in importance is the region in which Tangaloa was regarded as supreme being, a region nearer the centre of recent cultural evolution, namely, Samoa, Tonga, and the Society Islands. Later intrusions or borrowings come from Melanesia and America, the Melanesian coming by way of Fiji and Tonga, or by borrowings of Polynesian voyagers, the American by the borrowing of Polynesian adventurers who found their way to Mexico and Peru. The Indo-Polynesian religions show traces of ancient Indic. south-east Asiatic, historic Hindu, and Chinese influ-It may be that the fusion of the first three may have taken place in south-east Asia or Indonesia before they were carried to Polynesia, while the Chinese influences may have been brought in by stray Chinese Tan-kah-lo-seafarers of the river population

'ELEPHANT HEADS' IN MAYA SCULPTURES.—Mr. J. Elic Thompson. Field Director of the British Museum Expedition in British Honduras, in an article in the Scientific Monthly for November, revives the question of the significance of the 'elephant heads' in the drawings of Maya sculptures at Palenque made by Waldeck at the beginning of the last century Waldeck unquestionably intended to portray elephants' heads and his treatment of the tapir is distinctive. Mr Thompson points out that not only is Waldeck's accuracy in other matters not above question, as is shown by reference to Maudslay's work, but also he was strongly influenced by a belief in the Asiatic origin of American culture and that this might have influenced his interpretation of an indistinct original. As the originals have since perished, the question is beyond solution one way or the other by direct evidence. Mr. Thompson summarises the arguments for and against judicially, but holds that even if the case for the elephant were proved, it would not support the diffusionists, though the attitude that America was never affected to any appreciable extent by Asiatic culture would have to be abandoned. Recent archæological research has shown that of the essential elements in the culture for which 'diffusion' is claimed, agriculture and pottery-making antedate the elephants by at least a thouasnd years.

Function of the Epiglottis.—The epiglottis is a tongue-shaped cartilaginous flap situated at the anterior border of the larynx. It used to be thought that this structure acted as a 'lid' to the larynx, falling back over the laryngeal aperture in order to prevent ingress of food or liquid during swallowing. This view was shown to be erroneous by Stuart. who proved that during swallowing the epiglottis actually moves forward and does not fall back. Moreover, when the epiglottis in man is destroyed by disease, swallowing remains unaffected, and many animals do

not possess it yet swallow periectly. Mr. V. E. Negus (Jour of Anatomy, vol. 62. Pt. 1, 1927, p. 1) now suggests that the principal function of the epiglottis is to preserve the integrity of the olfactory sense (smell) when the mouth is open; it prevents entrance of air by the mouth by apposition to a long soft palate, thus compelling the inspired air to pass through the nose. The epiglottis is best developed in deer and antelopes, animals which largely rely on powers of scent for their actual existence, and in carmivores such as the wolf and hon, which are, therefore, able to open the mouth widely and yet to preserve undiminished the integrity of their powers of scent. In some instances the epiglottis may subserve a subsidiary function in respiration and in deglutition, but not in phonation, and song birds do not possess it

COCCIDIOSIS IN CATS AND DOGS —Justin M. Andrews (Amer. Jour Hygiene, vol 6, pp. 784-798, Nov. 1926) has studied the course of infection with Isospora felis and ruolta in cats The incubation period is two to four days, and the duration of symptoms does not usually exceed a week The preparent period (from the administration of the oocysts to the appearance of the parasites in the fæces) is usually five of six days. and the patent period averaged about thirty days. There was some indication that the severity of the miection varied directly with the number of oocysts originally administered. One attack of coccidiosis seems to render cats and dogs non-susceptible to subsequent infection by the same organism. This immunity lasts for seven months, and probably for The author considers that Isospora hominis is peculiar to man, and that it occurs more frequently than has been reported.

The Luminous Organs of Watasenia —G. Shima (Proc. Imp. Acad. Tokyo, July 1927) in a note on the nature of the luminous bodies of Watasenia scintillans. refers to the three classes of luminous organs present in this squid. In one of these, innumerable rod-shaped bacteria occur in the luminous cells, and in the other two classes of organs similar bacteria occur. though in fewer numbers. A pure culture—a colony—of the bacteria of the first organ when placed in a dark chamber was found to emit light of the same nature as that produced by the luminous organs of the live squid. The part of the luminous organs of the live squid. The part of the luminous organ in which the bacteria occur gives a lipoid reaction. The author points out that luminous bacteria have been recorded hitherto in the Myopsida, but now they are shown to be present in Watasenia, which belongs to the Egopsida. In another œgopsid. Enoploteuthis chunii. the author has found similar bacteria in the luminous organs, which correspond to the second and third classes of organs in Watasenia.

The Nucleus of Amæba.—Monica Taylor, S.N.D, states (Quart. Jour. Micr. Sci., vol. 71, Pt 2; 1927) that long and careful examination of cultures has failed to reveal any trace of syngamy in the life-instory of Amæba proteus. Metcalf stated that the life cycle of this species may require a year for its completion, and this is substantiated by the present author. The development period during which the culture contains no adults or very few is followed by one during which the adults increase rapidly in numbers because of fission. The latter period may be prolonged almost indefinitely by sub-culturing, but without such interference it lasts almost six months. The nucleus of the young amæba is disc-shaped, and consists of a karyosome more or less centrally placed

in a reticulum of nucleoplasm Chromatin in varying amounts is present in this reticulum. The karyosome is a much more conspicuous object in the developmental stages than in the adult, possibly because in the latter the chronatin blocks under the nuclear membrane arrest attention. The deeply staining portions of the karyosome in both young and old amoba contain chromatin and the latter passes out at intervals to the nucleo-reticulum, gradually making its way to the periphery as the nucleus grows in size, so that in adults ready to form encysted young the karvosome appears to consist of a vacuolated reticulum of nucleoplasm. When the nucleus is fully adult the chromatin of the periphery becomes subdivided into patches, large and not regular to begin with, but later forming 'blocks' These blocks are therefore bits of the karyosome which in turn give rise to the chromatin blocks that escape into the cytoplasm of the agamont and form the karyosomes of the agametes. The author concludes that the rudiment of the nucleus in a developing A proteus is wholly karyosomic and remains so throughout the encysted condition.

THE THEORY OF SAND DUNES —A new development in the theory of sand dunes is made by Dr. Vaughan Cornish in a recent paper on "Waves in granular material formed and propelled by winds and currents (Geophysical Supplement. Monthly Notices, R.A.S., July 1927, pp 447-467). It refers to waves in ridges. the crests of which are not level but undulating, with alternate peaks and saddles. Since the formation of these has been observed during a period of constant wind, the phenomenon cannot be regarded merely as a complication due to veering winds: it is a definite dynamical feature of the final stage of dune development in an unconsolidated material. It is natural to expect that collapse will occur, in a series of steep sand-waves transverse to the wind, if the current increases too quickly, and also that breakdown will take place first at special points, determined by accident; what requires explanation is the persistence of the peaks which remain after such breakdowns  $\mathbf{D}_{\mathbf{I}}$ Cornish finds evidence, from the form and size of the small ripples on the windward slopes of the ridges. indicating that over the windward face of the peaks there is a confluence of the winds towards the saddles, and that the convergence results in a spinning movement that increases the scouring action in front of the saddles. On the lee side of the ridge, the finer particles carried in the vortex may be deposited behind the peaks, though in some cases it was found that deposition occurred behind the saddles, the ground immediately behind the peaks being at a lower level

CONTINUOUS X-RAY SPECTRA.—One of the outstanding problems in connexion with the production of X-rays, that of the origin of the continuous spectrum, has been studied by W. Duane in an investigation described in the September number of the Proceedings of the National Academy of Sciences. A modified Coolidge bulb was built in which the effective target was a small volume of mercury vapour at low pressure. This was excited by a homogeneous beam of electrons the energy of which was just insufficient to remove the L electrons, whilst the softer M rays produced were unable to pass through the mica observation window of the tube. The feeble intensity of the resulting pencil precluded the use of a spectrometer, and its average wave-length had therefore to be found by measurement of the absorption coefficient in aluminium. Quoting from one set of results, the average wave-length was 1 10 A., whilst that corresponding to the applied potential was 1.04 A., a difference of only 6 per cent. The conclusion drawn from these and similar data is that in at least a large number of im-

pacts the electron transfers the greater part, if not all, of its kinetic energy into radiation, and that the latter is nearly, if not exactly, monochromatic

Electrification by Friction —In a communication to Nature, Mr. W A Macky, of University College, Auckland, gives a preliminary account of his experiments on the effect of the pressure of the surrounding gas on the electric charge produced by rubbing together a metal disc 2 cm in diameter and The metal disc. an insulating disc 3 cm in diameter of aluminium or steel, was connected to an electroscope with a condenser in parallel and the readings of the instrument were taken on separating the discs atter their flat surfaces had been rubbed together by rotating the disc of insulator. As the pressure of the gas was reduced, the readings of the electroscope fell for discs of glass, sulphur, and ebonite, from 100 volts at atmospheric pressure to 2 or 10 volts at less than a centimetre of mercury, while for discs of silk or chamois, the fall was only to about 75 volts. Similar affects were found in air, oxygen, to be aware of the work of McClelland and Power, or of the theory of Riecke) When the insulator disc was of glass, any faulty insulation caused the reading of the electroscope to increase to amounts of the order of 850 volts when the rubbings were repeated without the discs being discharged. This effect the author ascribes to the charge on the insulator disc leaking to the back surface and therefore not taking part in the withdrawal of the charge from electroscope and condenser when the two discs are brought together. The electroscope in consequence shows a residual charge, to which rubbing adds the normal charge, and as a result the total is increased.

SUPERCONDUCTIVITY.—Superconductivity was the name given by Onnes to the peculiar type of electrical conduction which is exhibited by certain metals at the extremely low temperatures obtainable by the use of liquid helium He found that the electrical resistivity of certain metals as, for example, mercury, tin, and lead, decreases at first uniformly as the temperature is lowered The resistivity then decreases less rapidly until the critical temperature is reached, when it suddenly drops to less than  $10^{-12}$  times its value at It was also found that if the specimen at  $0^{\circ}$  Kelvin a temperature less than the critical temperature was placed in a magnetic field and the field was gradually increased, the resistance became normal at a certain critical value of the magnetic field. It was further found that if the specimen were immersed in a bath the temperature of which was maintained at a value somewhat less than the critical temperature, then when the current in the specimen was gradually increased, the resistance of the specimen suddenly became normal for a certain value of the current. In 1917, Silsbee made the suggestion that this critical current and the critical magnetic field were not independent phenomena. It is highly probable that the threshold current is that which produces a field equal to the critical magnetic field. Onnes and his associates did a large amount of experimental work the results of which support this hypothesis. In Scientific Paper No. 556 of the Bureau of Standards, Silsbee makes a detailed analysis of the experimental results got at Leyden. His results support the assumptions on which his theoretical work is based.

Radio Direction-finding.—The Department of Scientific and Industrial Research has issued a special report (No. 5) on radio direction-finding by Dr. R. L. Smith-Rose (London: H.M. Stationery Office; 1s. 9d). It summarises the progress that has been made in this

direction during the last five years. A comprehensive survey of the subject is given and the results obtained during the last two years are included. A theoretical discussion on broad lines is also given. This proves the notable contribution which the study of directionfinding has made to the solution of the important problem of the propagation of radio wave- round the The explanation of the propagation of radio waves round the earth as merely a phenomenon of diffraction presents many difficulties. A partial explanation can be made by making the hypothesis of a conducting layer in the atmosphere. Eckersley showed that while the transmission of vertically polarised waves by the conducting layer was sufficient to explain the measured values of radio signal strength. it was necessary to assume that the down-coming waves at the receiving end contained a horizontally polarised component in order to explain the variations in the apparent bearings observed on direction-finders. Experiments strongly confirm this theory. As the result of the intensive research being carried out in various parts of the world on the propagation of radio waves, the mechanism of the actual deflexion from the ionised layer is rapidly being placed on a satisfactory quantitative basis. The author concludes that the appreciable errors which occur when using the direction-finder at night are caused by the down-coming waves polarised with the electric force horizontal. As a direct result of the theoretical analysis, a system of direction-finding has been developed in which the night errors to which all closed coil systems are apparently hable have been reduced to a negligible amount.

A New Cathetometer. - The cathetometer is a laboratory adjunct of which the cost is usually much more impressive than the range of accomplishments. A pattern recently produced by Messrs. Casella, of 49 50 Parliament Street, Westminster, therefore disturbs a tradition. This instrument is not only strikingly versatile, but also, strangely enough, is being put on the market at a much lower figure (£26) than its more simple predecessor. The central vertical column, supported by a heavy flat tripod with adjustable feet. is present as in the earlier type, but the telescope carriage, instead of travelling thereon, rides upon two of the three vertical brass rods which form a sort of cage rotating about the central column. One of these rods is engraved with a scale of 1 metre divided into millimetres and readable by vernier to 0 05 mm. The carriage can slide freely or may be rigidly clamped at any height on the scale, it can also be adjusted by fine motion sciews for height and level. Similarly, the cage can rotate freely, may be rigidly clamped to the central shaft, or may have its motion finely controlled. The central column has a head and levelling screw, so that the whole apparatus may be laid horizontally. In this position the apparatus will serve as a reading telescope for use with a balance or galvanometer, or it may be used as a comparator of length, either by means of its accessory mountings, for end gauges, or, by changing the object glass, for measures of length.

The Surface Tension of Molten Metals and Alloys—The surface tensions of molten tm, bismuth, cadmium, lead, zinc, and antimony have been redetermined by Yosiharu Matuyama by a dropping method (Science Reports. Tohoku Imperial University, vol. 16, No. 5, June 1927, p. 555)—At the melting points the values in vacuum for the six metals are 591, 401, 67.9, 479, 800, and 375. The surface tension falls linearly as the temperature is raised, the values at 600° C being for the first five about 51 6, 350, 602, 432, and 755. The constant in Eotyos equation

connecting the surface tension with temperature is tound to vary from 0.9 to 1.2 for tin, bismuth, lead, and zinc. The method has been applied to the three allov systems, cadmium-antimony, zinc-antimony, and lead-antimony. In each case the tension falls from that of the metal with the higher value to that with the lower on a fairly gentle curve, rapidly at first and later more slowly. In the two former systems, however, there are small breaks at compositions corresponding with the compounds CdSb and Zn<sub>3</sub>Sb<sub>2</sub>. The conclusion drawn is that these compounds do not dissociate consoletely on fusion

THE CRYSTAL STRUCTURES OF AMMONIUM, POTAS-SIUM, AND RUBIDIUM CUPRIC CHLORIDE DIHYDRATES. In the September issue of the Journal of the American Chemical Society, S. B. Hendricks and R G. Dickinson describe the results of an investigation of the crystal structures of the compounds R2CuCl4.2H2O, where R represents ammonium, potassium, or rubi-The study of salt hydrates and ammoniates by the methods of X-ray analysis is, in general, rendered difficult by their low crystallographic symmetry, and this case was no exception. Laue and spectral photographs were used and their interpretation necessitated a very careful examination of reflection intensities. For each of the salts, the structural unit contains two R2CuCl4.2H2O and is based on a simple tetragonal lattice. Each copper atom is immediately surrounded by two oxygen and four chlorine atoms, two of the latter being at a distance from the copper 0.75 A. greater than the distance of the other two. Each alkalı atom is surrounded by four oxygen atoms, four copper atoms and eight chlorine atoms. The inequality of the two copper to chlorine distances is naturally assumed to indicate that the copper exerts different forces on the two pairs of chlorine atoms, and this fact, together with the behaviour of these compounds in solution, seems to show that they are of the double salt rather than the complex salt type. In the case of K2CuCl4.2H2O the dimensions of the structural unit were found to be  $d_{100} = d_{010} = 7.45$  A. and  $d_{001} = 7.8$  A.

A STUDY OF THE STRUCTURE OF THE SURFACE OF ORDINARY SOLUTIONS .- A long contribution on this subject describing work carried out by J. W. McBam and G. P. Davies has just appeared in the September issue of the Journal of the American Chemical Society. As compared with the large amount of data for films of insoluble materials resting on the surface of a solvent such as water, very little is known about the structure of the surfaces of solutions. The determinations of Donnan and Barker of the absolute adsorption of a substance from true solution at the air interface, using nonylic acid solution, are thought to be inaccurate, and an improved method is described. The adsorptions per square centimetre of surface of aqueous solutions of p-toluidine, camphor, and amyl alcohol are given, and these amounts are considerably in excess of those required for a monomolecular surface film. It is suggested that, in addition to a monomolecular film, there is an excess concentration in the immediate neighbourhood of the surface and chains of oriented molecules extend inwards into the solution. The authors point out that this conception affords an explanation of some other results. numerical results obtained are in disagreement with Cabbs's formula, and the authors use the strict thermodynamic formula of Gibbs, taking into account all the components present, even the gas in contact with the surface. It is also considered essential to include terms not in the Gibbs equation in order to allow for the electrical effects which occur at all surfaces.

### Synthetic Formaldehyde.

FORMALDEHYDE, which is greatly in demand for disinfection and for the manufacture of artificial resms and synthetic dyes and drugs, was at one time chiefly imported into Great Britain as a 40 per cent aqueous solution (formalin) at a price which stimulated investigations into the possibility of its synthetic production. Since it is made by the catalytic dehydrogenation of methyl alcohol, usually over a copper contact mass, its price will naturally be dependent on that of wood spirit, and hence on the demand for wood charcoal, unless alternative supplies of the alcohol become available, as is now in fact the case. The falling exports of wood distillation products from the United States of America, and the large natural sources of gaseous hydrocarbons within the Empire, are facts which mdicated clearly enough the direction in which research should be undertaken. The Chemistry Research Board of the Department of Scientific and Industrial Research consequently decided to explore the possibility of the economical production of formaldehyde by the oxidation of hydrocarbons.

The work was carried out at the Royal Naval Cordite Factory, Holton Heath, Dorset, and is the subject of a report entitled "The Production of Formaldehyde by Oxidation of Hydrocarbons" (Chemistry Research, Special Report No. 1) by Messrs. W. Ledbury and E. W. Blair, which has just been published by H.M. Stationery Office (2s. net) This report deals both with the production of the formaldehyde and with its recovery from aqueous solutions. Although the account of the investigations shows that the formaldehyde can be manufactured according to the proposed process in the form of a dilute solution, it is pointed out that the commercial success of the method has been forestalled by a greater success: that of the manufacture of methyl alcohol ('methanol') from

mixtures of carbon monoxide and hydrogen By this means the price of formaldehyde has been reduced from £130 to £40 per ton, and even the United States of America is importing from Germany supplies of this commodity

Valuable information, however, has been gained in connexion with the concentration of dilute formal-dehyde solutions, and the Board has wisely decided to place on record the whole of the data. The Report first describes the production of formaldehyde by the controlled oxidation of ethylene, methane, etc., much of the work has already been published in detail, and is therefore familiar to those interested in the subject. The Report covers the transition of the laboratory experiments to semi-technical processes; the use of coal gas has also been examined, but the cost was found to be prohibitive except during emergency periods. A semi-technical investigation of the absorption by water of dilute formaldehyde vapours is next described, and reference is made to the bisulphite and ammonia compounds of formaldehyde.

The section on the recovery of formaldehyde from aqueous solutions commences with a description of a laboratory investigation of the distillation of formaldehyde solutions at atmospheric pressure, followed by the results of large-scale tests, and experiments on distillation under pressure and continuous distillation. Incidentally, it was found that iron, even in the form of an alloy containing only 9 per cent. of that metal, is unsuitable for use in the construction of stills for formaldehyde solutions on account of its activity in causing decomposition of that compound, whilst nickel, aluminum, and copper are non-reactive. The cost of concentration appears to be such that it is uneconomical to concentrate by distillation a solution appreciably weaker than 1.5 per cent.

### History of the Desert Flora of the Old World.

DETAILED analysis of the systematics and distribution of various typical desert plants of central Asia has led the Russian botanist, M. G. Popov, to some very interesting general considerations on the origin and history of the desert flora of the Old World (Bull. Univ. Asia Centrale, Tashkent, livr. 15, 1927, pp. 239-292)

According to Popov's views, the primitive desert flora developed so early as in the Cretaceous, or even the Jurassic period. To this time must belong such forms as Welwitchia, Ephedra, etc., and the centre of origin must have been in the central parts of the Gondwana continent. Destruction of the latter resulted in the shifting of the main desert area into the southern hemisphere, where a continuous landmass existed during the Cretaceous period and a free exchange of desert forms between South Africa, South America, and Australia could take place. During this period such great groups of desert plants were developed as Zygophyllaceæ, Geraniaceæ, Rutaceæ, Capparidaceæ, etc., and for this complex of forms the author proposes the name of the Welwitchia flora.

At the same period the African continent was connected by the Lemurian with India, and over this bridge desert forms from South Africa migrated through the Deccan into central Asia, while northward migration of the desert flora on the African continent itself went so far north as the southern shores of the sea of Thetis, which occupied the place of the Sahara. Thetis separated the region of the Welwitchia flora from more northern parts of the Arctogæa, where a

very different mesophilous flora, which originated on the Angara continent, developed

Parallel with the migration of purely desert elements from South Africa northwards, there was an interchange of less xerophilous plants between western Asia and South Africa, by way of East African table-lands; in this way Erica, for example, migrated from south to the north, and Dianthus in the opposite direction. The disappearance of the Lemurian bridge separated the South African desert region from Asia, while the lowering of the East African mountains resulted in its separation from the Mediterranean deserts.

A further stage of the development was due to the disappearance of the Thetis sea, in place of which the vast desert belt stretching from Sahara to Mongolia developed. These deserts were invaded by the Welwitchia flora which already flourished on the southern shores of the Thetis. In this way the very uniform ancient Mediterranean flora was formed, and its further evolution consisted in extensive interchange of forms with America, by way of the Northern Atlantic. This, together with the dying-out of many ancient elements of the Welwitchia flora in the Palæarctic deserts, owing to changes of edaphic conditions, led to further changes in the flora of the latter now entirely separated from the South African desert region. As a result, a special desert flora was evolved, which may be called ancient Mediterranean, or Iranian, but its history is to be discussed in a later paper by the same author.

### Anniversary Meeting of the Royal Society.

GIR ERNEST RUTHERFORD, in his presidential address at the anniversary meeting of the Royal Society on Nov 30, referred to the scientific careers and work of the twelve fellows and three foreign members who died during the year. Among other subjects surveyed in the address are the publications of the Society and the attendance at the ordinary meetings. Sir Alfred Mond, on behalf of Imperial Chemical Industries, Ltd., has offered a subscription of £1000 a year until further notice to help to meet the deficit on the publication account, in substitution of that of £500 a year for three years made by Messrs Brunner, Mond and Co. in 1925, and the Council has gratefully accepted the gift. Since the War there has been a notable increase in the number of papers published by the Society. This is specially marked in the 'A' Proceedings, where, in place of one volume a year before the War three or four volumes now appear, the separate numbers being issued with proinptness and regularity '

As one means of increasing the interest, and therefore the attendance, of fellows at the incetings of the Society, facilities have been provided for the display of experiments or demonstrations in the tea-room

before and after the reading of papers

We print elsewhere in this issue Sir Ernest Rutherford's remarks upon the results of investigations carried out in recent years to produce intense magnetic fields and high voltages for general scientific purposes; and we subjoin extracts from descriptions of the work of this year's medallists.

#### Presentation of Medals.

THE COPLEY MEDAL, AWARDED TO SIR CHARLES SCOTT SHERRINGTON.

Sherrington early chose as the special field of his investigations the physiology of the central nervous system. To this, during some thirty years, he has steadily devoted his great skill in experiment, bringing the immense complexities of its function within the range of objective analysis, and revealing fundamental plan and orderly sequence in the reflex actions by which it controls the activities of the body, and continuously adjusts them to the environment. The results of this work have been embodied in a series of some two hundred original memoirs, presenting a continuous record of progressive investigation. The earlier stages have been brought under review and treated synthetically by Sherrington in his now famous Sillman Lectures on 'The Integrative Action of the Nervous System.' In these he deals with the occurrence and significance of the muscular rigidity which appears when the higher brain is removed, with the co-ordination of muscular movements by reciprocal excitation and inhibition of antagonistic muscles. with the rhythmical, phasic activity which the conflict produces in the centres concerned with certain movements, and with the appearance of a purposeful character which the integrating action impresses on many forms of reflex response The influence of Sherrington's investigations has spread far beyond the limits ot his own laboratory and has inaugurated a new era in neurological investigation throughout the world.

## A ROYAL MEDAL, AWARDED TO PROF. JOHN CUNNINGHAM MCLENNAN

For more than thirty years Dr J. C. McLennan has been an industrious and enthusiastic experimenter, his papers being mainly concerned with radioactivity, gaseous conduction of electricity, the spectra of the elements, and the liquefaction of gases. Among

his works of outstanding merit may be mentioned the measurements he has made with his pupils on the fine structure of spectral lines which are of much importance to modern theories of the mechanism of the Recently he has had quite sensational success in tracing to its source the elusive auroral line \5577. an extremely difficult task which had baffled the skill of many previous investigators. This is important not only in itself but also on account of the information it yields as to the structure of the upper atmo-Apart from his own private researches he has built up a most efficient school of physics in Toronto. and is largely responsible for the present strong position of physical science in Canada. He has devoted much energy to the establishment of a cryogenic laboratory in Toionto, a heavy task which he has carried out with much success.

#### A ROYAL MEDAL, AWARDED TO SIR THOMAS LEWIS.

From 1911 onwards to the present day, Sir Thomas Lewis has taken a leading part in the remarkable growth of our knowledge of the mammalian heartbeat, which has been one of the conspicuous scientific achievements of the period in question. Lewis s researches enabled him to locate the point of origin of the beat, and to plot out the course of the wave of excitation over the ventricles and anticles of mammals. By extending these observations to the hearts of representative vertebrates, he was able to compare the modes of spread of the wave with the special forms of the electrocardiagram, and thus to appreciate clearly the meanings of the several deflexions. Further extension to diseased hearts led to the interpretation of the abnormalities of the electrocardiagraphic record

In 1911 Lewis was able to show that, as Cushny had previously suggested, certain cardiac irregularities are due to fibrillation of the auricles; and his later clinical and experimental work on auricular fibrillation and flutter suggest that the irregularities are due to the formation of an endless circulating wave of contraction in the auricles. Quite recently he has published the results of investigations of the peripheral circulation, upon which he has been engaged during the past

twelve years.

## THE DAVY MEDAL, AWARDED TO PROF ARTHUR AMOS NOVES

Prof. Noyes's researches have been chiefly concerned with the properties of solutions, in particular of electrolytic solutions. Soon after the inception of the electrolytic dissociation theory of Arrhenius, it was recognised that all was not well with the strong electrolytes. Whilst qualitatively their properties were accounted for by the theory, there yet existed marked quantitative discrepancies. Accurate measurement of the properties of such solutions was the first requisite for the attack of the problem, and to this task Noyes applied himself. His investigation of the conductance of aqueous solutions up to temperatures as high as 300° forms a classical example of exact physicochemical measurement executed under conditions of great experimental difficulty.

His work on the influence exerted by one salt on the solubility of another, on transport numbers and the mobilities of the ions, on the ionisation of pure water at different temperatures, is all directed to the same end. Noyes showed the importance of the classification of the strong electrolytes according to their valency type and, more than twenty years ago, attempted to take into account the electrostatic forces between the ions. He thus foreshadowed the modern

amongst other workers.

#### THE BUCHANAN MEDAL, AWARDED TO DR. MAJOR GREENWOOD

Dr. Greenwood is specially distinguished for the statistical study of medical subjects, having applied the statistical method to the elucidation of many parablems of physiology, pathology, hygiene and epidemiology. He has been pre-eminent in encouragmg and developing the use of modern statistical methods by medical laboratory investigators and in securing the adequate planning and execution of field investigations. He is almost unique in the possession of both the medical knowledge and mathematical ability which are essential in these researches.

### THE HUGHES MEDAL, AWARDED TO DR WILLIAM DAVID COOLIDGE

Science is under a great debt to Di. Coolidge for the invention and production of a new type of X-lay tube, called by his name, of great flexibility and power, which has proved of great service not only to medical radiology but also in numerous scientific researches In the last few years he has applied his unrivalled technical knowledge to the generation of high-velocity cathode rays, which can be passed into the air through a thin window as in Lenard's pioneer experiments thirty years ago. Such researches are of great importance to science, as they promise to provide us with new methods of obtaining a copious supply of swift electrons and high-speed atoms of matter for experimental investigations.

### University and Educational Intelligence.

CAMBRIDGE -Mr. G E. Wherry has been elected to an honorary fellowship at Downing College Mr H A. Roberts, Secretary of the Appointments Board, has been elected to a tellowship at Gonville and Caus College Mr F. C Phillips has been elected to a fellowship at Corpus Christi College

Prof Nuttall, Magdalene College, has been re-elected Quick professor of biology. Mr. F. C Bartlett, St John's College, has been reappointed reader in experimental psychology. Miss M. S. Willis, Girton College, has been appointed demonstrator in geography.

It is proposed to add the Astronomer Royal, the Hydrographer of the Navy, the Director-General of the Ordnance Survey, and the Chief of the Geographical Section of the General Staff at the War Office to the committee for geodesy and geodynamics.

LONDON.-Prof. E. C. Williams, who has held the Ramsay Memorial chair of Chemical Engineering at University College since 1923, has resigned in order to occupy an important post in the Shell Oil group. His business will be the active development of the group's research organisation in California. Prof. Williams, who was a distinguished graduate and scholar of the University of Manchester, was employed for five years by the British Dyestuffs Corporation, and for one year as research chemist to the Joint Committee of the University of Leeds and the National Benzole Association At University College, in temporary buildings, he has conducted courses of instruction on lines which he described in an inaugural address at the College in 1924. His work has been remarkably successful, and abundant evidence is forthcoming of the advantages gained by students who have added to their ordinary university curri-culum in chemical science a period of study in the Ramsay Department of Chemical Engineering. The measure of success achieved has encouraged the

theory now so widely developed by Noyes himself | College to an immediate and considerable develop-A very strong and inment of the Department fluential committee has been formed for the purpose of collecting a building and endowment fund, with Sir Alfred Mond as chairman, Sir R Waley Cohen as vice-chairman, Sir David Milne Watson as honorary treasurer, and Sir Frank Heath as honorary secretary

The title of professor of chemistry in the University has been conterred on Dr J. F Spencer, in respect of the post he holds at Bedtoid College Prof. Spencer studied at University College, Liverpool, and at the University of Bieslau Since 1905 he has worked in the Department of Chenustry at Bedford College; in 1915 the title of reader in physical chemistry was conferred on him, and since 1919 he has been head of the department His published work includes "The Metals of the Raie Earths" (1919), "An Experimental Course of Physical Chemistry," "The Magnetic Susceptibility of some Binary Alloys (with M E. John, Proc Roy Soc, A, 1927), and numerous papers in chemical journals

A course of five free public lectures on "The Technique of Bacteriological Research" will be given by Mr. F. W. Twort, at the Royal College of Surgeons of England, on Dec. 5, 7, 9, 12, and 14, at 4 o'clock.

OXFORD -Sir Edward Farquhar Buzzard, of St. Thomas's Hospital, Physician Extraordinary to the King, the newly appointed Regius professor of medicine, is well known as the author of numerous treatises upon diseases of the nervous system. He was one of the first of a highly talented succession of medical men at Magdalen College, including Drs. Jex-Blake and Golla of St. George's, Dr Huist of Guy's, Dr. Singer and Sir Bernard Spilsbury. He has also filled the office of secretary of the Royal Society of Medicine.

The wing of the Engineering Laboratory, recently completed, was open to the inspection of a large party of guests invited by the Vice-Chancellor and Prof. Jenkin on Nov. 24. By this addition, much-needed space will be found for the electrical equipment of the . laboratory. Demonstrations were given of the methods of using the various testing machines

An examination for the Radcliffe Travelling Fellowship, for which women are now also eligible, will commence on Feb 14, and candidates are requested to send in their names to the Regius professor of medicine on or before Feb 1, 1928.

THE King has consented to open the new buildings of University College, Nottingham, which have been given by Sir Jesse Boot, probably some time in July

SIR JAMES CURRIE, formerly Principal of the Gordon College at Khartum and Director of Education in the Sudan, has been appointed chairman of the governing body of Imperial College of Tropical Agriculture, in succession to Sir Arthur Shipley, who died on Sept. 22 last.

The Committee of Award of the Commonwealth Fund Fellowships announces that it is now prepared to receive applications for the fellowships to be awarded in 1928. Last year there were 115 candidates, and 22 appointments were made. The fellowships are normally tenable at an approved American university for two years, and are open to persons of British birth domiciled in England, Scotland, Wales, and Ireland, who are graduates of recognised universities and are unmarried, and not more than thirty years of age. Women as well as men may apply. Provision amounting approximately to £600 per annum will be made for the total expenditure involved during the tenure of a fellow-hip. Applications must be forwarded through the authorities of the university of college of which the candidate is, or was, a member. The form of application can be obtained from the Secretary to the Committee, Mr. R. H. Simpson, 50 Russell Square, London, W.C.1. Applications must reach the Secretary by Feb. 18 next.

COURSES in anthropology of the University of Pans for the coming session announced to open in December or early in January offer the usual wide field to the student. At the Instaut d'Ethnologie. among the lecturers in courses for the diploma and certificate are M. Mauss (ethnology), M. Rivet (anthropology), and the Albe Breuil archéotogic evolution There are also courses of instruction in linguisties, biological and zoological anthropology quaternary geology and paleontology and the physiology of man and the anthropoids. Under the Faculty of Higher Education a great variety of subjects is offered in preparation for the examination of the Institut d Ethnologie, the lectures being distributed among various of the constituent institutions of the University They cover ethnology. archæology, sociology, human geography, linguistics and phonetics, physical anthropology, and human palæontology and geology. As usual, special attention is given to the culture and languages of the natives of the French possessions both in Africa and the Farther East

Ax address on "The Royal Society of Aits its Services to Trade and Training was delivered on Nov. 2 by Sn Philip Magnus, who has succeeded Sn Thomas Holland as chamman of the Society's council. The admess has just been published in the Society's journal Sir Philip shows clearly that the "Society for the Encouragement of Arts, Manufactures, and Commerce," as it was called when it was founded in 1754, has kept its original purpose steadily in view. Until the middle of the nineteenth century the method chiefly used was the award of prizes of money and medals for discoveries and inventions. Whilst encouraging applications of science to commerce, it strove to discourage commercialism among men of science, restricting the grant of its prizes to those who published their discoveries for the public good. This ban on patented inventions was withdrawn in 1844. About this time the Society, impressed by the value of the evening technical classes provided by the Mechanics Institutions, took a leading part in the formation of a union of these bodies, and in this connexion initiated exhibitions of educational appliances. It was as an adjunct to these activities that the Society's examinations, now an important factor in the organisation of commercial education in Great Britain, were started in 1854 Originally designed on a comprehensive plan, including many non-technical subjects, the scheme was remodelled in 1876 so as to exclude all except subjects closely connected with trades and crafts. and was further restricted in 1879 to commercial subjects. To-day, with candidates numbering between sixty and seventy thousand, its examination system is the biggest in the world. Its value as an educational factor is now to be investigated by a departmental committee appointed by the Board of Education to inquire as to it and other systems of examination of part-time students "with particular reference to the place and value of examinations as an element in training for industrial, commercial, and professional activity.

### Calendar of Discovery and Invention.

December 4 1827—Though the Admiralty had possessed stramboats from 1822, the first commissions for the command of steam vessels ever granted to haval orners were those signed by the Duke of Clarence, then Lord High Admiral, on Dec. 4, 1827, when HMSS Lightning, Meteor, and Echo were commissioned by Lieuts, Evans, Bullock, and Hay, respectively. This official recognition of steam vessels as auxiliary waiships may be said to mark the birth of the steam Navy of Great Britain.

December 5, 1879 —Among those who extended the use of the camera in astronomy was Sir William Abney Beginning his experiments on the chemical action of ied and infra-red rays in 1874, he obtained a substance sensitive to these rays and with it explored a vast unknown and ever-invisible region of the solar spectrum. his map of which was pre-ented to the

Royal Society on Dec. 5, 1879.

December 7, 1820 — Davy was first elected president of the Royal Society in 1820, and his presidential address was read on Dec. 7. His address was entitled Discourse on the Present State of the Royal Society and on the Progress and Prospects of Science," and it contained much respecting Davy's own views on science.

December 8, 1610.—One of the earliest users of the telescope was the English algebraist. Thomas Harriot, who in 1609 made sketches of the moon and later observed the newly found satellites of Jupiter. Harriot is also remembered for his observations of sunspots, which began on Dec. 8, 1610; from them he determined the sun's axial rotation.

December 8, 1864 — Maxwell, after taking his degree in 1854, read through Faraday's "Experimental Researches, and from that time adopted Faraday's conception of a medium as a guide throughout his electrical investigations. One of his earliest papers was "On Faraday's Linesof Force," read in 1855, but his great paper, "On a Dynamical Theory of the Electromagnetic Field," was read to the Royal Society on Dec. 8, 1864. In this, electromagnetic action was shown to travel through space at a definite rate in waves, and these waves to consist of disturbances which are transverse to the direction in which the waves were propagated "Nine years later, Maxwell expanded his work into his well-known." Treatise on Electricity and Magnetism.

December 8, 1874—Few astronomical phenomena have been looked for so eagerly or prepared for so assiduously as the transit of Venus of Dec. 8, 1874. Many methods for its examination were studied, some four score posts of observation were provided, and the expeditions cost nearly a quarter of a million sterling. The chief aim of the astronomers was to improve the determination of the sun's distance, but it was afterwards said, "As regards the end for which it had been undertaken, the grand campaign had come to nothing."

December 9, 1813 — The honour of making the manufacture and sale of gas a commercial success belongs to Samuel Clegg, the first chief engineer of the London and Westminster Chartered Gas Light and Coke Company. On Dec. 9, 1813, he took out a patent for a gas meter, and he also made the first large gasometer and invented the first pressure regulating device.

December 10, 1845—The original inventor of the pneumatic tyre was the Scotch engineer. Robert William Thomson, who on Dec. 10, 1845, patented a leather tyre with an internal rubber tube filled with air. He afterwards fitted such tyres on road carriages

### Societies and Academies.

#### LONDON

Royal Society, Nov. 17—T. Graham Brown: Absence of a linear relationship between graded simple reflex flexions and the relations thereof evoked by a constant extension producing stimulus. In decerebrate cats, graded flexion magnitudes of simple flexor shortening are obtained in response to flexion-producing stimuli of different intensities. Each of these simple shortenings is then subjected to the 'inhibitory' effect of a constant extension-producing stimulus—thus giving compound flexor shortening. Comparison of the magnitudes of simple flexor shortening and of compound flexor shortening fails to establish a linear relationship between the two.

T. Graham Brown Absence of a linear relationship between the reflex flexor shortenings evoked by a graded series of flexion-producing stimuli and the inhibitory' lengthenings of a constant extension reflex evoked by the same stimuli. In decerebrate cats, graded reflex magnitudes of simple flexor shortenings are obtained in response to flexion-producing stimuli of different intensities. Each of these stimuli is then compounded with a constant extension-producing stimulus, and the resultant lengthening (relaxation) of the extensor muscle is measured. Comparison of the magnitude of simple flexor shortening and of compound extensor lengthening fails to establish a general linear relationship between the two.

T. Graham Brown: The relation of the magnitudes of remaining reflex shortening in two antagonistic muscles during compound stimulation. Where two antagonistic reflex stimuli are applied concurrently, the remaining shortenings of two antagonistic muscles during compound stimulation are related to each other. This relation is such that in many cases where one or both of the reflex stimuli are varied in intensity, the sum of the remaining shortenings in the two antagonistic muscles (each measured as a ratio to maximal reflex shortening) is constant. In other instances this constancy fails, but a series of sums bears an approximate relationship of linearity to the magnitudes of the simple reflex shortenings evoked by the series of graded reflex stimuli which are used in the experiment. The most general statement of this relationship is as follows: The sum of the proportional remaining shortenings in two antagonistic muscles, Y, is linearly related to the simple reflex shortening, X, evoked at each intensity of the series of graded reflex stimuli used in a series of compound reflexes, i.e. Y = AX + B.

Sybil Cooper and D. Denny-Brown: Responses to stimulation of the motor area of the cerebral cortex. The spinal discharge evoked by cortical stimulation can follow the rate of repetition of break shocks in that stimulus up to about 180 a second, indicating a very simple synaptic relation between the pyramidal tract and the anterior horn cell. Rates of stimulus above and below that rate usually cause a total electro-myographic rhythm of 160 to 180 a second. Varying types of grouping of the spinal discharge occur, among them being that of a 'dominant' rhythm of 35 to 50 a second, with no relationship to the rate of stimulus. The typical motor response to stimulation of the motor area shows signs of concurrent inhibition. Clonic after-discharge, 'epilepsy,' and the form of the motor response are the result of a conflict between inhibition and excitation.

J. Lorrain Smith and T. Rettie: The distribution of lymphatics defined by autolysis of their contents. Autolysis post mortem of the liquid contained in the lymph forms doubly refractile globules of 'soap,' often in such quantity that the lumen of the channel is

filled continuously. Lymphatics of the liver are defined because in them the globules form abundantly and at a stage when, as yet, no sign of them is to be found in any other site.

Geological Society, Nov 2.—J. A. Douglas and W. J. Arkell. The stratigraphical distribution of the Combrash. I. The south-western area. The stratigraphical distribution of the Cornbrash in south-western England, from Oxford to the south coast near Weymouth, is described, and the eleven brachiopod zones proposed by Mr. S. S. Buckman are discussed. The new records are added to Mr. Buckman's faunal range-diagram, and in this way it is shown that many of his conclusions regarding penecontemporaneous erosion and non-sequences in the Cornbrash, as expressed in his clinal diagram, have been based on insufficient data. A twofold rather than a threefold subdivision of the Cornbrash is advocated.

Linnean Society, Nov. 3 .- R. W. T. Gunther: Exhibition of rotographs of some unpublished letters of John Ray The letters were written by Ray to the. antiquary, John Aubrey, and to the Keeper of the Ashmolean Museum, Edvard Lhwyd, between 1676 and 1703 It is proposed to print them *in extenso* as an extra volume in the Ray Society's series, together with Ray's letters to the secretaries of the Royal Society.—T. A. Sprague: The botany of Brunfels. Brunfels' interest in plants seems to have been chiefly confined to their medicinal properties, on which his classification was largely based, with the result that some of his 'genera' were highly artificial; 'Scrophularia,' for example, included Scrophularia nodosa, Sedum Telephium and Ranunculus Ficaria. His use of the terms 'male' and 'female' sometimes indicated differences in flower-colour between two plants which were otherwise more or less similar, the deeper colour in the following order—red, blue, yellow, white-being 'male,' and the paler colour 'female' The term 'female' in other cases indicated a spurious kind or an abnormality. His herbal contains the first recognisable illustrations of many of the Lunnean species, of which indeed they may often be regarded as the historic types.—S. K. Mukerji: The biological relations of Mercurialis perennis L. The known range of M. perennis has been considerably extended, and the discontinuity in distribution of the genus is more apparent than real. Seed output is low compared with many other woodland species, and only about 10 per cent. of the seeds formed in England are germinable. The root-system shows branched and unbranched roots, both infected with fungi, particularly the former. Shallow rooting is associated with very high water content of soil, and the lower the acidity the deeper the penetration. Great variation in leaf form and size occurs. The leaf margin bears hydathodes secreting an acid liquid containing potassium chloride and calcium carbonate. An intergradation of sex has been observed. Pollination is partly entomophilous but mainly anemophilous. The fruit explosively ejects the seeds to a distance of about 4 metres. M. perennis shows no correlation between dry weight and the total carbonate content of the soil, and it is apparently not a true calcicole but an oxyphobe. It shows decided preference for soils with a high organic content. Light intensity distinctly affects the distribution and growth of individuals of the different sexes separately, and light intensity may determine the sex of a plant under certain conditions.

Optical Society, Nov. 10.—J. R. Hamblin and T. H. Winser: On the resolution of gratings by the astigmatic eye. An investigation of the resolution of gratings by the human eye, commenced by H. H. Emsley in 1925, is continued. The irregular curves

representing variation of grating acuity from meridian to meridian is of the same general form in all astigmatic eyes. Experiments show that the images of gratings placed in various directions, which are produced by an ordinary astigmatic system, show irregularities of the same form due to the overlapping of the blurred images of the separate lines of the gratings. Thus an eye with regular astigmatism will exhibit irregularities in resolving gratings at various inclinations, and charts consisting of fine parallel lines are not trustworthy for testing ocular astigmatism.

Physical Society, Nov. 11.-G. W Sutton: The power-factor and capacity of the electrodes and base of triode valves, with special reference to their use in thermionic voltmeters. A discussion of the conditions under which a three-electrode valve-voltmeter should be operated to ensure a minimum power consumption, and at the same time to give indications closely proportional to the square of the input voltage; and a sumple method of adjusting the operating voltages to fulfil the necessary conditions.—H. Lowery: (1) The refraction and dispersion of (1) air, (2) oxgven, (3) gaseous chloroform; (2) New determinations of the gaseous refractivities of (1) acetone, (2) methyl ether, (3) ethyl ether The refractivities of air, oxygen and gaseous chloroform have been found for the green mercury line ( $\lambda 5461$ ), and the dispersion studied over the range \4800 to \6700. The gaseous refractivities of acetone, methyl ether and ethyl ether for λ5461 have also been measured.—Panchanon Das: The theory of the elastic pianoforte hammer. By making various approximations, formulæ are obtained from which it is possible to deduce the practical effect of the elasticity and velocity of the hammer, and of the position of its point of impact on the string.

#### EDINBURGH.

Royal Society, Nov. 7.—A. W. C Menzies and P. R. C Macfarlane: Some further notes on the salmon of the River Moisie, Eastern Canada. Moisie catch is chiefly composed of salmon which have spent either 2 + or 3 winters in the sea, and one of the main features of interest is the high proportion of 'spring' fish which arrive in June and July—83 per cent. in 1923 and 41 per cent. in 1924. Grilse apparently are almost entirely absent from the Gulf of St. Lawrence rivers (only one was found in this Moisie collection), although they are present in large numbers in Newfoundland, and, apart from the two age groups already mentioned, the catch is composed almost entirely of fish on their second or third return to the river: 13 per cent. in 1923, and no less than 29 per cent. in 1924 belong to this last class of fish, which consequently form a proportion far beyond that usually found in European rivers. The average weight of the Moisie large spring fish, 20.5 lb., is much the same as that of similar fish on the eastern side of the Atlantic. but the weight of the 2 + winters group, 10.5 lb., is only comparable with that of the earlier of the migrants of the same history in Great Britain. Recovery after spawning is evidently rapid and growth is good. Only one-third of the smolts were two years old at migration, and the remainder were either three or four years of age.—L. H. Easson and R. W. Armour: Action of 'active' nitrogen on iodine. Experiments on the rate of the reaction between active nitrogen and iodine vapour and on the intensity of the light emitted for different pressures of rodine. emission of the line 185  $\mu\mu$  was observed and the evidence for the energy content of active nitrogen discussed.—J. W. Gregor: The pollination of Lolium perenne and L. stalicum. The prevalence of selfsterility in the agricultural grasses has indicated

methods of breeding, and an investigation of this problem was necessary preparatory to the study of the survival of growth forms within wild populations. It has not been possible, so far, to increase the selffertility of L perenne and L. italicum by changing the environmental conditions, or by artificial methods of pollination. The results obtained from plants under strictly controlled conditions have been confirmed by growing these plants in the field isolated from other plants of the same species.—Dorothy J. Jackson: Wing dimorphism in the genus Sitona and its inheritance in Sitona hispidula F. (Coleoptera, fam. Curculionidæ). Wing dimorphism is common in the genus Sitona and has been specially studied in S. hispidula. In the macropterous form of this species the wings are fully developed. In the brachypterous form the wings are small and truncated, and the metathorax is modified in structure. The dimorphism is well-marked in the pupal stage. Some of the macropterous insects are capable of flight, others have the wing muscles greatly reduced and histologically The macropterous and brachypterous abnormal. forms are widely distributed in Europe and occur frequently in the same locality. Breeding experiments conducted to determine the genetical relationship of the two forms indicate that the brachypterous condition is inherited as a simple Mendelian dominant.— B. Kaczkowski: Contribution to the studies of the origin of European sheep. Craniological investigations on the sheep having been found unsatisfatory, the method of serological isoagglutination was applied in an attempt to discover the ancestral types involved in the development of modern European sheep. Two main blood groups are present in sheep; one (A), as found in O. musimon and in Polish local sheep, being dominant to the other (O), as found in the Southdown. The latter group may be divided into two sub-groups, one with, the other without, anti-A. It would appear probable that differences in origin exist between the English Southdown and the Polish local sheep.—E. T. Copson: On Fourier constants. By the use of a theorem recently proved by Titchmarsh, certain convergence properties of series of Fourier constants are obtained. The results are connected with the generalised Riesz-Fischer and Parseval theorems, but cannot be obtained by the use of these.

#### MANCHESTER.

Literary and Philosophical Society, Nov. 1.-J. N. Langdon and Edna M. Yates: Transfer of training in manual dexterity. The doctrine of transfer of training states that training in any specific form of mental activity is capable of having its effects transferred to any other activity of the same form although dealing with different material. A group of 32 subjects was trained intensively for a fortnight, in a laboratory adaptation of a process employed in driving-chain manufacture. Tests of manual dexterity and muscular ability were given before training was commenced and at the ends of the first and second weeks respectively. The same tests were given to a group of 28 subjects who received no training. All the subjects were of roughly the same age and type, and in each case the subject's payment was calculated upon actual performance, hence the predominant incentive to satisfactory performance was a financial one and may be assumed to be constant. Statistical analysis of the results reveals that there is no significant difference between improvement in the test performances of the trained and control groups respectively. In fact, the brief practice afforded by the first giving of the test is more effective than the prolonged intensive training on a similar, but not identical, performance. There is evidence, then, that training in manual dexterity is specific and not general.

#### SHEFFIELD

Society of Glass Technology, Oct. 19.-J. F. Hyslop: Crystal growth and impact brittleness. The chief cause of brittleness in opal glass is the tendency of the glass to produce sharp angular crystals, and these may be formed by. (a) the tendency of the matrix to precipitate silica. If the opal is susceptible to this secondary devitrification, a careful choice of working temperature is necessary to avoid brittleness; (b) the tendency of the glass to grow angular instead of globular fluoride particles. This happens in a glass of low viscosity, and such a glass is brittle at low and high working temperatures.—E J. C. Bowmaker and J. D. Cauwood The detection of selenium in decolorised bottle glass. The glass is treated with hydrofluoric acid, a little strong nitric acid, and evaporated to dryness at about 90°C. Strong nitric acid is added to the residue, again evaporating to dryness. The residue is then dissolved with 1 · 1 nitric acid and a little water added Strong sulphune acid is added and the whole evaporated until fuming. After cooling, a piece of codeine sulphate is added with stirring, and the solution heated to furning A green coloration denotes the presence of selenium. Manganese and copper must be absent.

#### PARIS.

Academy of Sciences, Oct. 31.-Ch. Depéret: New observations on the neolithic deposits of Glozel (Allier). The authenticity of the deposits described by the author last year has been disputed. New excavations were made last July, in company with MM. Arcelin and Bjorn, of the Oslo Museum, under conditions which would render impossible the fraudulent introduction of objects. The author concludes that the date of the Glozel deposits dates from very early Neolithic and maintains the authenticity of the discoveries.—A. Lévèque. The theoretical solution of the problem of the exchange of heat by circulation of a non-viscous fluid in quiet movement, with velocity potential, inside a tube—A. Schidlof: The interpretation of the masses of the electron and proton in a universe of five dimensions -Boutaric and Mile. G Perreau: Refractometric measurements on colloidal solutions. Results of the application of the interference refractometer to colloidal solutions, especially the phenomena accompanying flocculation. — A. Travers. The ionic equilibrium  $Al(OH)_3 + 6F \rightleftharpoons AlF_6 + 3OH$ . Cryolite is stable over a wide range of pH.— Joseph Péneau: The age of the iron minerals attributed to the Gothlandian in the synclinal of Saint-Julien-de-Vouvantes.—Maurice Piettre: Remarks on agglutinating immunosera localisation of the agglutinines.-Henri Jean Frossard: The treatment of deafness by the Laennec method.-A. Leulier, P. Sedallian, and J. Gaumond: Diphteric toxin, nucleoproteids, and dialysis.

### ROME.

Royal Academy of the Lincei, June 19.—L. Palazzo: Results of a magnetic exploration in the Giuba and Uebi Scebeli (Southern Somaliland).—P. Vinassa: The 'electronic number 'and constituents of the globe. The electronic number, indicating the number of peripheral electrons which can be found in the various elements taking part in terrestrial combinations, seems to be not merely of geochemical interest, as it serves as the basis of a new classification of the elements.—C. Foà: The neurochemical mechanism of vagal inhibition in the heart of mammifers. The results of experiments on frogs indicate that stimulation of the cardiac vagus does not determine distance phenomena, and that the presence in the blood of a substance with

vagal action may be assumed .- L. A Herrera: Plasmogeny. Imitation of amœbæ by means of resin soap — S. Minetti · The Taylorian development  $\sum a_n z^n$ , where  $a_n = g(n)$  with g(n) wholly transcendental Laboccetta. Equations of geometrical figures comprising a parameter with variation of which the line or surface represented passes continuously from the polygonal or polyhedral form to the circular or spherical form.—P Nalli and G. Andreoli The area of a surface, Stieltjes' multiple integrals, and multiple integrals of functions of several complex variables.-G. Krall · Green's functions relating to pluri-connected fields.—F. Robles · Rayleigh's theorems of small oscillations -G Thomsen. Dynamics of rigid bodies in general relativity —A Masotti. Motions of a perfect liquid by plane strata —A. Carrelli The hydrodynamic interpretation of the quantum theory.— Gold purple. G. R. Levi and C Fontana supposedly cubical granules of gold in purple of Cassius have a side with the mean value 36 A. Addition of stannic acid has no influence on the degree of subdivision of the gold —G Malquori · The system,  $Fe(NO_3)_3 - KNO_3 - H_2O$  at 25°. Nonohydrated ferric nitrate and potassium nitrate form neither additive compounds nor mixed crystals at 25°. The solubility curves of the two salts project beyond the point of intersection, a metastable region being thus exhibited. —G. Natta: Crystalline structure of cassium trichloromercurate. This compound, CsHgCl<sub>2</sub>, obtained by crystallisation of the solution containing excess of cæsium chloride, crystallises in the monometric system. The elementary cell is cubic, the side being 5.44 A. The positions of the ions in the cell are defined by the following co-ordinates: Hg  $(\frac{1}{2},\frac{1}{2})$ ; Cs  $(0\ 0\ 0)$ ; Cl  $(\frac{1}{2},\frac{1}{2}\ 0)$ ,  $(0\,\frac{1}{2},\frac{1}{2})$ ,  $(\frac{1}{2}\ 0\,\frac{1}{2})$  The calculated density is 4.53.—A. Rejna. Crystalline structure of calcium hydroxide. For this compound the values given by Levi, namely. a = 3.52, c = 4.93, c : a = 1.40, are confirmed, the value  $u - \frac{1}{4}$  being assumed and the co-ordinates for Ca and O being Ca  $(0\ 0\ 0)$ ,  $0\ (\frac{1}{3}\ \frac{2}{3}\ u)$ :  $(\frac{2}{3},\frac{1}{3},u)$  —L. Scremin · Variations in the ionic equilibrium as factors of pharmacological action Potassium and convulsant drugs. When the equili-, Xa-Kbrium  $\frac{r_{a-1}}{Ca^{-1}Mg^{-1}}$  is modified in the sense of an increase in K+, the cells of the posterior cornu react far more

readily towards drugs which have the specific effect of mcreasing the reflex excitability. The cause of this action of the potassium ion is not known, but it may be due to the fact, observed by various investigators, that this ion renders the cell-walls more permeable and thus facilitates the entry of the drug.—P. Aloisi: Study of the manganiferous pyroxenes. Examination of two samples of Italian rhodonite reveals a variation in the sign of the double refraction with change of the relation between the manganese oxide and the oxides of other bivalent metals. This variation in sign appears to be accompanied by profound modifications in the whole orientation of the indicatrix.—A. Desio: Miocene echinoderms of Porto Bardia and of the oasis of Giarabub.—B. de Finetti: Conservation and diffusion of Mendelian characters. (11) General case. -E. Benedetti: Modifications in the course of alcoholic fermentation arising from the effect of the oscillating electromagnetic field on the yeast. When either 5 per cent. glucose solution or beer wort containing yeast is subjected to the action of an oscillating electromagnetic field for a short time, the velocity of the subsequent fermentation is diminished. As the action of the field is prolonged more and more, this effect increases to a maximum and afterwards changes to an acceleration of the fermentation, this again changing to a retardation for still longer exposures to the field.

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### Official Publications Received.

The New Zealand Astronomical Society (Incorporated) Bulletin No 3 1. Do we Live in a Spiral Nebula: by P O'Dea, in . I the Universe in a State of Cosmic Equilibrium' by F Gawith. Pp 19 Bulletin No 4 The Interior of the Earth and its relation to the Surface Features By P. O'Dea Pp 18 (Wellington, N.Z.) Proceedings of the Royal Society of Edinburgh, Session 192-1,27 Vol 47, Part 3, No 20 Tie Theory of Orthogonants and Latent Roots from 1881 to 145 By Sir Thomas Mun. Pp. 272-252 (Edinburgh Robert Grant and Son, London, Williams and Norgate Ltd.) 28 61 Seventh Annual Report of the Scientific and Industrial Research Council of Alberta, 1928. (Report No 20) Pp 58. (Edmonton, Alba., W.D. MacLean)

Council of Alberta, 1926. (Report No. 20) applied. Council of MacLean;
W. D. MacLean;
The Royal Technical College, Glasrow Annual Report on the One Hundred and Thirty-first Session, adopted at the Annual Meeting of Governors held on the 18th October 1927. Pp 74. (Glasgow.)
International Commission on Illumination Brief Report of the Bellagi) Meeting, 31 August—3 September 1927. Pp 23+2 plates (Teddington National Physical Laboratory) 2s., 50 cents

#### FOREIGN

Foreign

Scientific Papers of the Institute of Physical and Chemical Research No 85. Reversed Spectra of Metals produced by Explosion under Increased Pressure. By Mitsiliaru Fukuda. Pp 47-4 plates 50 sen, No 85. Uber die Beständteid ees Laganum (Echinodien). I Von Munic Kotake Pp 49-51 20 sen, No 87. Synthests of the Homologue of Urushiol II By Sin in Kawai. Pp 53-60 20 sen No. 88. Uber die Kondensationsprodukte des Isatins. Von Munic Kotake I Synthese der 2,3-Dioxy-5,4 dihydro eninolin-1 carbon-aire Fp 61-65 20 sen. No 80 "PCR Piston Ring and the Packing Ring Fester. By Masatosi Ökochi and Keikieni Ebihara Pp 67-80-plates 5-7 30 sen. No 90 "Experimental Study on the Combustion of Mixtures 6-1 Wickgen with Air or Oxygen in Eudiometer By Torahiko Termia, Kiyoniko Yumoto and Ukuro Nakaya Pp 81-125-12 plates 50 sen. No 91-4 A Theory of the Specific H-at the Latent Heat of Fision and Vaporation being taken into Consideration. By Uzuna 10a. Pp 129-147 30 sen. No 97-96 Unitersuclungen über die Cellidoseester der aromatischen Sulfo-auren, von Ichiro Sakurada und Tadashi Nakashima; Über die Cellidoseester der aromatischen Sulfo-auren, von Ichiro Sakurada und Tadashi Nakashima. Pp. 197-225 25 sen. No 97 Analysis of the Niodam and Timist in Giodips By Isaburo Wada and Sechi Kato. Pp 227-263 35-sen. No 98. Some Remarks on the Colloul Theory of Cements. By Tutori, Macia. Pp. 205-269 20 sen. No. 99 Effect of Giann Boundary apon the Hawliness of Alamminus. By Keip Yamaguchi. Pp. 271-890+1 pl. 10. 35 sen. No 100-10a. The Formation of Oxyderivatives of Dynhenjelme Oxide from Resorein, by Yojin Isabuk. A Method of deteri ining Molecular Weights of Organic Substances in small Quantities by means of Freez pg. Point Defrees. On the Calabita Action of Redneed Copperor. Is doorned, by Tersusaki, Ikeda, A new Process for the Synthesis of Cambior, by Tersusaki, Ikeda, On the Oxidation of Isobornyl Acetate with Ozone by Tersusaki, Ikeda, On the Oxidation of Isobornyl Acetate with Ozone by Tersusaki, Ikeda, On the Oxidation of Isobornyl

### CATALOGUES.

CATALOGUES.

The Wild-Barfield Electric Kiln. Pp 4. (London: Automatic and Electric Furnaces, Ltd.)

A Complete Catalogue of Constable Books Part I General Literature, Part 2 Technical, Scientific Educational and Medical (Revised to October 31, 1927) Pp vin+184 (London Constable and Co, Ltd.) Cleavance Catalogue of Miscellaneous Books (No 503) Pp 42. (London Francis Educards, Ltd.)

Books Beautiful. Pp 32 (London: George 6 Harrap and Co., Ltd.) X-Ray News and Cimical Photography No 3, October Pp. 25-40 (London: Kodak, Ltd.)

The Cambridge Bulletin No 58, November Pp. 20+4 plates (Cambridge: At the University Press.)

### Diary of Societies.

#### SATURDAY, DECEMBER 3.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10 a m — S. Hastings and G. R. Scarff. Some Notes on Paracusis William from the Ferens Institute of Otolarymgology.—Dr. D. McKenzie Posterior (Mastord) Dramage in Acute Supplication of the Middle Ear Royal Institution of Great Bertain, at 3.—G. Holst. Samuel Wesley and Robert Pearsail (III)
Institute of British Foundamen (Lancashire Branch) (at College of Treinology, Mauchester), at 4—E. Longden. Foundry Practice in the United States of America.
Institute of Chemistry (Manchester and District Section) (at Manchester)—Address by Chairman.

chester) -Address by Chairman.

#### MONDAY, DECEMBER 5.

MONDAY, DECEMBER 5.

CAMBRIDGE PRILOSOPHICAL SOCIETY (in University Chemical Laboratory), at 4.30 — Dr. E. K. Rideal. The Electron Work Function and Surface Action — W. H. Mills and K. A. C. Elhott. Molecular Dissymmetry Dependent on Restricted Rotation about a Single Linking. The Optically Active Forms of Renzenessiphonyl.8-nitro-1-naphthyliglycine. — To be communicated by title only — Dr. F. G. Mann. Note on the Configuration of the Tetrammino-platinous Complex — Prof. E. T. Whittaker: Note on the Law that Light rays are the Null Geodesics of a Gravitational Field — Miss M. D. Kennedy: Two Sets of Conditions for Expansion in a Laurent's Series. — S. Pollard: A. Condition for Inverting the Order of Integration in a Repeated Integral.—Dr. F. Bath: On the Quintic Surface in Space of Five Dimensions.

ROYAL SOCIETY OF EDINBURGE, at 4:30—Prof. E. T. Whithker: The Induence of Gravitation upon Electric Phenomena—Prof. C. G. Darwin. The New Outlook on the Mechanics of the Atom—To be read by the maly—Miss Nellie B. Eales. The Anatomy of a Fostal African Elephant, E., no. appearant (Lo obonia arrindna). Part 2. The Body Muscles—Prof. H. W. Turnball. The Invariant Theory of the Quaternary Qualitatic Complex. 1. The Reduced System.
VICTORIA INSTITUTE (at Central Hall, Westminster), at 4:30.—Dr. J. A. Fleming. Minner in Nature and in the Biblical Literature indicating a Common Origin in a Supreme Intelligence.
ROYAL INSTITUTION OF GREAT BRITAIN, at 1—General Meeting.
BRITISH PSychological Society (Education Section) (Annual General Meeting) (at London Day Training College), at 5:39—At 6:15—D. W. Oates. An Experimental Study of Tenjerament.
Society of Engineers (at Geological Society), at 6.—Dr. W. Rushton: The Preservation of the Parity of River Water with Regard to Pisciculture.

culture

In Preservation of the Parity of River Water with Regard to Pisciculture
Institution of Althomobile Engineers (Western Centre) (at Merchant Venturers' Technical College, Bristol), at 0.45 —Prof. Browning: Pinking and Dopes
Institution of Electrical Engineers (Informal Meeting), at 7—
N.E. Jackson and others. Discussion on An Heating and Conditioning.
Royal Society of Arts, at 8.—Prof. H. C. H. Carpenter. Aloy Steels, then Manufacture, Properties, and Uses (Cantor Lecture) (IV.)
Society of Chemical Industry (London Section) (at Chemical Society), at 8.—Dr. H. S. Hatheid Automatic Aralysis of Liquids and its Application to Control of Wart Softening Plants.
Royal Geographical Society (at Eolian Hall), at 8.30.—Major J. C. Cooper Cark and G. Laws. Lubantum
University of Birmingham Chemical Society (Birmingham University)—Prof. T. M. Lowry: Rec. at Advances in Stereochemistry.
Institution of the Rubber Industry. (Undon Section) (at Engineers' Club, Coventry Street, W.).—W. W. Hamili: Efficiency Methods in the Rubber Industry.

### TUESDAY, DECEMBER 6

ROYAL INSTITUTION OF GREAT BRITAIN, at 515 -Sir William H. Brage A Year's Work in X-Ray-Crystal Analysis (III)
INSTITUTE OF MARINE ENGINEERS, at 030 -Sir Westcott S Abeil. The

INSTITUTE OF MARINE ENGINEERS, at 6 30 —SH Westcott S Adent the Story of the Ship Institution of Electrical Engineers (East Midland Sub-Centre) (at University College, Nottingham), at 647—D S. Munro Modern Electrical Wilmig as applied to Small Houses.

Electrical White as applied to Small Houses
ROYAL PHOTOGRAPHIC SOCIETY of GREAT BRITAIN (P. total Group),
at 7—A C Bandeld: Some Odds and Ends from the New World
INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section)
(JOULDY with Society of Chemical Industry—Edinburgh and East of
Scotland Section) (at 36 York Place, Edinburgh), at 7-30.—Sir James
Walker. Electro synthesis
North-East Coast Institution of Engineers and Shipbuilders
(Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7-30.
INSTITUTE OF MITALS (North East Coast Local Section) (at Armstrong
College, Newcastle-upon-Tyne), at 7-30.—J. E Newson. Hot Extrusion
Process.

Process.

QUEERTT MIGROSCOPICAL CLUB, at 7:30—Dr. H. M Leake Some Aspects of the Plant in Relation to Disease.

INSTITUTION OF ALTOTOBLIE ENGINEERS (at Royal Society of Arts), at 7:53—W A. Whatmough Control in Carbination.

ROYAL ANTEROPLICATION INSTITUTE at 8:30.—Dr. A. C Haidon: Notes on the late R B. Deacons Investigations in Malekula, New Hebrides.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at \$30 -G Jefferson, Dr. G Riddoch, Dr. B Shirrs, G Stebbing, and St J. D Buxton: Discussion on Fractures of the Spine

### WEDNESDAY, DECEMBER 7.

GLASGOW UNIVERSITY ALCHEMISTS' CLUB (in Glasgow University), at 859.—Debate
ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr L. R Lempriere
The Health of the Public School Bov
ROYAL SOCIETY OF MEDICINE (Surgery Section) (at St. Thomas's Hospital).
at 4.—Demonstrations

at 4.—Demonstrations
'EWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING

AND TFOHNOLOGY (at Institution of Mechanical Engineers), at 530 —
J W Hall: Making and Rolling Iron (Presidential Address).
INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6 — Dr. H.
Lapworth: The Effect of Pumping Operations on Underground

Waters

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6—R H. Barfield The Attenuation of Wireless Waves over Land

INSTITUTION OF AUTOMOBILE ENGINEERS (Branford Branch) (at Belle Vue Hotel, Bradford), at 7—F. H Paul' Design and its Effect on Maintenance Charges

Society of Chemical Industry (Glasgow Section) (jointly with Edinburgh Section, Institution of the Rubber Industry, and the Institute of Chemistry) (at Cad' One Restaumant, Glasgow), at 7—Dr. D F. Twiss. Sulphur in Rubber Manufacture—C Chapman. Naphthas and their Uses.

INSITUTION OF ELECTRICAL ENGINEERS (Tags. Side Sub Central (et Class)

Institution of Electrical Engineers (Tees-Side Sub Centre) (at Cleveland Technical Institute, Middlesbrough), at 7—H Pateison: Chairman's Address

man's Addifess
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall), at 7.—E. A. Alliott: Institution Laundries.
INSTITUTE OF METALS (Swansea Local Section) (at Thomas' Cafe, Swansea), at 7.—R. Genders. Entrusion.
INSTITUTION OF SANTIARY ENGINEERS (at Caxton Hall, Westminster), at 7.—G. T. Cotterell The Use of Reinforced Concrete in Waterworks and Sawagos

7.—G. T. COULETEIL THE USE OF ACHITOCOC CONTROL AND SEWAGE.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8—H Toms. Oil Bromide Films and their Use in Determining the Halogen Absorption of Oils—G. Middleton

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and F C. Hymans: Tests for Impurities in Ether —Dr H J Stern Arsenic in Coated Papers and Boards —Demonstrations.—Apparatus for Determining Benjoic Acid in Foods, by Dr G W Monier-Williams; Sodium Flame for Polarimetric Work, by T McLachlan and A W Middleton
Royal Society of Aris, at S—S J Duly The Damage to Cargo due to 'Ship's Sweet'
Extravological Society of London at S.—Prehendary Gound G. G.

ENTENDEDGICAL SOCIETY OF LONDON at S.

EUGENICS SOCIETY (at Linnean Suc ety), at S.—Prebendary Gough G. G.

Coulton, and others D. Sastious Pinlanthropy

SOCIETY OF CHEMICAL INDUSTRY (Nottinguam Section) — Prof. R

RODINSON 'The Indole Gloup of the Alkaloids

INSTITUTION OF MICHANICAL ENGINEERS (Liverpool Branch) (jointly
with Liverpool Engineering Society)—H Gutteridge, Modern Port-

land Cement Plant

ROYAL MICROSCOPICAL SOCIETY (Biological Section)

#### THURSDAY, DECEMBER 8.

ROYAL SOCIETY, at 430 —R W James and E M Firth An X-ray Study of the Heat Motions of the Atoms in a Rockalt Crystal — I Waller and R W. James On the Temperature Factors of X-ray Reflection for Solium and Chloring in the Rocksalt Crystal —To be read I Waller and R. W. Janes. On the Temperature Factors of X-ray Reflection for Solium and Chlorine in the Rocksalt Crystal.—To be need in title only.—G. Nonhebel, J. Colvin. H. S. Patterson, and Dr. R. Whytlaw-Gray. The Coagulation of Smokes and the Theory of Smoluchowski.—P. I. Dee: The Moudity of the Actinium A. Recoil Atom measured by the Cloud Method.—A. C. Menzies. Shifts and Reversals in Fuse Spectra.—Prof. C. G. Parwin. The Electron as a Vector Wave.—W. Sucksmith, H. H. Picttei, and L. Broadway. The Magnetic Properties of Single Crystals of Nickel.—Prof. L. N. G. Filom. On the Second Approximation to the 'Oseen' Solution for the Motion of a Viscous Fluid.—Prof. C. V. Raman and K. S. Krishnan. A. Theory of the Optical and Electrical Properties of Liquids.—E. W. R. Steace and F. N. G. Johnson. The Solubility of Hydrogen m. Silver.—Dr. R. L. Smith-Rose and R. H. Barheld. Fuither Measurements on Wireless Waves received from the Upper Atmosphere.—Dr. F. H. Constable Spectrophotometric Observations on the Growth of Oxide Films on Iron, Nickel, and Copper.—J. W. Lewis. An Experimental Study of the Motion of a Viscous Laquid contained between two Coavial Cylinders.—C. E. Inglis: Oscillations of a Bridge caused by the Passage of a Locomotive.—G. R. Goldsbrough: Tides in Oceans on a Rotating Globe.—W. F. Sheppard: The Fit of a Formula for Discrepant Observations.—J. Taylor. On a Photoelectric Theory of Sparking Potentials.—Prof. G. G. Darwin: Free Motion in the Wave Mechanies.—Prof. A. Fowler The Spectrum of Phorime (F. I).—Lord Rayleigh: (a) Series of Emission and Absorption Bands in the Mercury Spectrum; (b) The Line Spectrum of Mercury. Occurrence of the Forbidden Line A2270.—W. H. Taylor and J. West. The Crystal Structure of the Chondrodite Series.
Royal Profographic Society of Medicine (Balneology Section), at 5.30.—Dr. W. Davies: Samuel Hyde Memorial Lecture
Royal Profographic Society of Reat Britain (Colour Group—Informal Meeting), at 7.—F. J. Trition: Demonstration of Tiree-colour Carbro.

Carbro.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub Centre) (at University College, Dundee), at 7:30.—R. J. Lawson A. Description of Modern Telegraph.

OPTICAL SOCIETY (at Imperial College of Science), at 7:30.—Instructor Capt T. Y. Baker. The Design of Reflecting Prisms.

INSTITUTE of METALS (London Local Section) (jointly with Institute of British Foundrymen) (at 83 Pall Mall), at 7:30.—W. A. C. Newman Structostance.

Strip Casting.

ROYAL SOLETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.), at 8.15.—Dr W Fletcher: Recent Work on Some Malayan Fevers.

INSTITUTION OF MECHANICAL ENGINEERS (Yorkshire Branch) (at Leeds) — J. H. Barker Chairman's Address, INSTITUTION OF MECHANICAL ENGINEERS (Western Branch) (at Bristol) — W. A. Stainer Chairman's Address, Oil and Colour Chemists' Association.

#### FRIDAY, DECEMBER 9.

INSTITUTION OF WATER ENGINEERS (at Geological Society), at 10:30 a v — Capt. W. N. McClean: Rainfall and Flow-off, River Garry, Inverness-shire.—S R. Raffety: Underground Water Supplies, and the Need for Investigation of the Sources thereof.—J. W. Madeley: Failure of Slow Sand Filtration in Madras City.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4:30—Sir David T Chadwick: The Indian Tariff Board: Discriminating Protection in Practice.

Practice.

Chadwick: The Indian Tariff Board: Discriminating Protection in Practice.

BIOCHEMICAL SOCIETY (in Imperial College of Science, Metallurgy Theatre, Royal School of Mines, South Kensington), at 4.45.—H. Henderson Smith, M. Hume, and I. S. MacLean: On the Presence of Vitamin A and Provitamin D in Yeast Fat.—W. J. Morgan and R. Robison: Dephosphorylated Methylhexosides derived from Hevose-diphosphoric Acid.—J. Pryde and E. T. Waters: Organic Phosphates from Rabbit's Muscle.—H. R. Hewer, H. Jairam, and S. B. Schryver: The Chemical Changes Taking Place in the Proteins of Muscular Tissue when Passing into Rigor.—H. J. Holman and S. B. Schryver: The Basic Hydrolysis Products of Certain Plant Proteins, and the Method of Separation.—E. J. Candlin and S. B. Schryver: The Belationship of Pectin to Hemicellulos.—E. C. Grey Studies on the Nutrition of Pigeons.—R. K. Christy and W. Robson. Estimation of Chlorides in Biological Finids.

ROYAL ASTROSOMICAL SOCIETY, at 5.—Dr. J. Evershed: The Solar Rotation and the Einstein Displacement derived from Measures of the H and K Lines.—W. M. Smart: The Constants of the Star-streams from the Groningen Proper Motions.

Paysical Society (at Imperial College of Science), at 5.—H. P. Walmissiey: The Scattering of Light by Individual Particles in Smokes.

A Mailley: On the Construction and Standardisation of an Interferomatics Pressure Gauge.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6
INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7—
Wajor S. J. Thompson Economics in Engineering
NORTHE - EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS
(Informal Meeting) (at Newcastle-upon-Tyne), at 7 15—C W Cairns
and others: The Relation between the Drawing Office and the Shipyud and Engine Works
JUNIOR INSTITUTION OF ENGINEERS, at 7 30—T G Rose Management

Graphies
INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7:30—Prof C H Desch Stresses in Non Ferrous Castings.
OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7:30—Prof A. G Green The Application of Methods of Dyestuff Analysis in the Examination of Pigments and Laboratory. Lakes.

Lakes
UNIVERSITY OF BIRMINGHAM CHEMICAL SOCIETY (Birmingham University)—Sir John Russell Chemistry in Relation to Agriculture
Society Of Dyers and Colourists (Manchester Section) (jointly with
Institution of the Rubber Industry—Manchester Section) (at Manchester)—W E Sanderson The Colouring of Cold Cured Rubber

#### SATURDAY, DECEMBER 10

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 -F J M. Stratton . Recent Developments in Astrophysics (I)
Physiological Society (at Bedford College for Women)

#### PUBLIC LECTURES.

#### SATURDAY, DECEMBER 3

HORNIMAN MUSEUM (Forest Hill), at 3 30 .- C Daryll Forde: Natural

#### MONDAY, DECEMBER 5

ROYAL SOCIETY OF MEDICINE (Barnes Hall), at 5 15 —Col P. S. Lelean: The Mind and Health (Chadwick Lecture)
ROYAL SCHOOL OF MINES (Imperial College of Science), at 5 30 —Prof H Briggs The Ventilation of Mines from the Engineering Standpoint

(Succeeding Lectures on Dec. 7 and 8.)

#### TUESDAY, DECEMBER 6.

UNIVERSITY COLLEGE, at 5 15 -H. Clifford Smith . The Equipment of a Mediæval House.

#### WEDNESDAY, DECEMBER 7

Bedford College for Women, at 5.15.—Prof Mary W. Calkins Conceptions of Meaning and of Value. (Succeeding Lecture on Dec 0) King's College, at 5.30.—Dr. E. Barker: The University and the University College.

London School of Economics, at 6—R. Sloley: Office Machinery. Demonstration of the Telegraphone.

#### FRIDAY, DECEMBER 9.

East Anglian Institute of Agriculture (Chelmsford), at 7.~-W. G. Hatton The Growing of Black Currents

#### SATURDAY, DECEMBER 10

HORNIMAN MUSEUM (Forest Hill), at 3 30 -Miss M A Muriay The Legacy of Egypt

#### CONFERENCE.

#### DECEMBER 7, 8, 9.

Institution of Chemical Engineers (at Chemical Society).

Institution of Chemical Engineers (at Chemical Society).

Wednesday, Derember 7, at 5—N. Swindin Submerged Flame Combustion
Thuisday, Derember 8, at 5.—G. W. Daniels: The Design of Refrigerating
Plants—L. Chew The Practical Aspect of Refrigerating as applied
to the Chemical Industry—R J. Mitchell Electrical Automatic
Refrigerators for Domestic Use
Finday, December 9, at 5—W. J. Jones The Problem of Industrial
Lighting, with some reference to the Chemical Industry.—At 8.—R.
G. Parker, D. N. Jackman, and J. N. Vowler: Continuous Weighing
of the Contents of Vessels The Weighmeter.—A T. Green: The
Properties of Silica and Fireclay Refractories in relation to their
Industrial Usage.

#### CONGRESSES.

DECEMBER 7 AND SUCCEEDING DATES.

FIFTH PAN-AMERICAN CHILD CONCRESS (at Havana, Cuba)

#### DECEMBER 13 10 16.

International Conference on Light and Heat in Medicine and Surgery (at Central Hall, Westmanster)

Sureerry (at Central Hall, Westmusster)

Dec 13 and 14 (Section 1).—Light and Heat in Medicine and Surgery —
Dr. F. Nagelschmidt Ultra-violet and Bioluminescence —Dr. L. G.
Dufestel: Contra-indications for Ultra-violet Therapy.—Dr. F. Hernaman - Johnson . Conjoint Ultra-violet Radiotherapy and Internal Medicine.—Dr. J. Saidman. The Therapeutic Uses of Infra-red Rays.—
Dr. E. P. Cumberbutch: Recent Advances in Diathermy Treatment —
Dr. H. S. Banks: The Place of Actinotherapy in Public Health Work.

Dec. 15 (Section 2).—Scientific Research in Relation to the Practice of Actinotherapy:—Prof Leonard Hill The Ultra-violet in Sunlight-and Artificial Sources —Prof. I. M. Heilbron: Vitamin D and its Relation to the Irradiation of Foodstuffs.—Dr. F. H. Humphris. Can the Chemist and Physicist be of Use in Actinotherapy "(Section 3).—Recent Advances in Optics:—S. G. Tibbles: Light and Vision—I. Spiro: The Treatment of Certain Common Eye Diseases in the Young by General U-V Irradiation.—Dr. K. R. Smith. Eye Muscle Training.—Dr. F. W. Edridge-Green: Colour Vision.



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No. 3032, Vol. 120]

#### The Technical Expert in the Civil Service.

N every government department, much of the work dealt with to-day involves the consideration of problems which are of a technical character, and presents, in consequence, the need for close collaboration on the part of officers belonging to the administrative, financial, and technical branches of the department. In view of the importance and, in many instances, the complexity of the technical aspects of these problems, not only is it essential that the careers offered in the technical branches of the Civil Service shall be such as to attract men of the highest standard of qualifications, but it is also necessary that the status accorded to the technical officers shall in every way be equivalent to that of the administrative officers with whom they are required to co-operate, in order that their position in the official hierarchy may correspond with the magnitude of their responsibilities, and thus effectively ensure that due weight may be given to their proposals.

When the system of recruitment by competitive examinations was extended, now nearly sixty years ago, to the superior grades of the Civil Service, the work of government departments was almost entirely administrative in character, and the State had then only very recently entered upon its responsibility as the undertaker of an important technical enterprise, the telegraphs. The number, therefore, of men with a scientific training and technical experience required in superior positions in the Civil Service was strictly limited, and, in consequence, the competitive examination system did not apply to the technical staffs. But even then it was recognised that men of a superior standard of qualifications were required for the more important positions on the non-technical side of the Civil Service, and steps were accordingly taken to provide a career in the higher division (now the administrative class) which should prove attractive to graduates of British universities; and at one time a career on the administrative side was practically the exclusive privilege of those who had entered the Civil Service by the higher division competitive examinations.

Since the termination of the War, the administrative and clerical branches of the Civil Service have been completely reorganised on the lines of the Report of the Joint Committee of the Civil Service National Whitley Council issued in \*February 1920, and in connexion with this reorganisation an assimilation of the various grades of the administrative and clerical classes of the Civil Service has

been effected; an improvement in the salary scales has, in some cases, taken place; and provision has been made for recruiting the administrative class partly by selection from inside the service. However, a proportion of the vacancies in the administrative class will, in the future, still be filled by men selected for appointment to the public service by means of an open competitive examination in the subjects embraced by the various honours courses of university institutions. Again, on the recommendation of the Asquith Committee, the salaries of the permanent heads of the principal departments of the State were, in 1920, raised to £3000 per annum, being in the majority of cases an increase of 50 per cent. on the pre-War scales

The developments which have been taking place in the activities of government departments during the past fifty years having had the effect of making administration dependent to an increasing extent on factors of a technical nature, their problems must, in many cases, be subjected even at the initiation stage to investigation at the hands of 'experts.' Further, where specialised knowledge is required, it is these 'experts' who have to work out the details; and, in the subsequent stages, the duty necessarily falls upon them to supervise the execution of schemes, and they then become responsible for much of the administrative work involved.

The altered conditions affecting the work of government departments have naturally resulted, in recent years, in a considerable increase in the numbers of the established officers of the 'expert' class. The increase between the years 1914 and 1923 was approximately 36 per cent. At the same time, a higher standard of professional knowledge has been called for and obtained. In spite of this transformation, no attempt has, however, so far been made to bring about a classification of the professional group, nor has any general scheme been introduced to provide a career on the 'expert' side equivalent to that offered to the non-technical civil Certain improvements in the salary scales of the various grades of the professional group have, it is true, taken place; the salaries of the heads of the professional and technical departments have been raised, but the increases fall far short of the proportionate improvements in the salaries of the permanent heads of the principal departments of the State mentioned earlier, and the salaries of the professional and technical chiefs are to-day approximately two-thirds and one-half only of those of the administrative chiefs. This disparity between the salary scales of the technical and non-technical staffs is carried down into the lower grades; it is not confined to the officers employed at the headquarters of government departments, but exists, although to a less marked degree, also in the cases of officers employed in the provinces.

It has further to be borne in mind that the differences in the salary scales are accentuated by the fact that promotion is normally quicker on the nontechnical than on the technical side, and, therefore, the superior positions on the former side are, as a rule, reached at an earlier age, on an average, than positions on the latter side carrying equivalent The methods of entry into the responsibilities various groups of the Civil Service differ so widely that a general comparison of the periods of time taken to reach the several salary scales of the administrative, clerical, and professional groups in the ordinary course of departmental promotion would be misleading. However, m order to provide a concrete illustration, the careers have been traced of six university graduates who entered the administrative class (old higher division) during the period 1905-1908, and an equal number of university graduates who entered the technical side of the same department, during the same period, under an open competition scheme, the average ages of the entrants into the two classes being about the same.

On the administrative side, the average time taken by these six officers to attain the salary scale £700-£900 (the maximum of which is reached after eight years in the grade) was  $12\frac{1}{12}$  years, one of these officers was promoted to an appointment on a salary scale £1000-£1200 (the maximum of which is reached after four years in the grade) 1810 years from the date of entry into the service. On the other hand, on the technical side the average time taken by the six officers to obtain their first step of promotion to the grade carrying (in London) a salary scale £450-£550 (the maximum of which is reached after four years in the grade) was 15½ years, two of these officers were promoted to the next higher grade carrying (in London) the salary scale £600-£700 (the maximum of which is reached after four years in the grade) after serving, on an average,  $18\frac{5}{12}$  years. It is perhaps not surprising, then, that of twenty-six university graduates recruited during the period 1907-10 on the technical side of the department in question, 68 per cent. should have resigned their appointments; the high percentage of these resignations seems to indicate that, in this instance, the career provided on the technical side of the Civil Service is not sufficiently attractive to university graduates.

Further, the foregoing analysis shows clearly that to undertake specialist duties of a technical character in the Civil Service results financially in the penalising of the 'expert' officers. An attempt is sometimes made to justify the inequality of the salary scales of the technical and non-technical groups in the Civil Service on the supposition that the responsibilities of the officers in these two groups are in no way comparable, the implication being that the duties of the technical group are of an order inferior to those of the non-technical group, but no reasoned or satisfactory arguments have been advanced to support such a contention.

The more favourable treatment of the administrative group as compared with that of the professional group has occasionally been defended on the assumption that as it is the former group that sanctions the expenditure voted by the legislature, a wrong decision on its part would involve waste and a loss of public money. This argument, however, assumes that the decisions of the administrative group are always sound and correct, and it entirely overlooks the fact that when decisions affect the sanctioning of expenditure on technical projects, the question as to whether such expenditure will be prudent and profitable, or extravagant and wasteful, will depend wholly on the skill with which the technical details have been worked out, the ability of the technical officers who supervise its execution; and on the care in relation to administrative details exercised by them Therefore, even in the event of a consistent absence of mistakes on the part of the administrative group, the actual avoidance of wasteful expenditure and of the unprofitable use of public money must, in the very nature of things, rest, so far as the preparation and execution of technical projects are concerned, directly on the skill, scientific knowledge, and technical experience of the professional group, that is to say, on factors which he wholly and exclusively in the sphere of responsibility of this group.

The contention has also been advanced in the past that owing to the great diversity of the duties which fall on the professional group of the Civil Service, and the fact that it is made up of not less than a hundred grades, it is not possible to devise a suitable classification scheme for this group. This plea has, however, lost much of its force now that an Act has been passed in the United States providing for the classification of civilian positions within the district of Colombia and in the field services (American Classification Act of 1923—Public—No. 516-67th Congress: H.R. 8928). Under this statute the 'compensation schedules,' that is, salary scales, are grouped under five 'services,' namely, (1) the professional and scientific service; (2) the sub-pro-

fessional service; (3) the clerical, administrative, and fiscal service: (4) the custodial service: and (5) the clerical-mechanical service. The numbers of grades in the several 'services' naturally vary. but a distinctive feature of the Act is that in the case of the two most important groups, namely, the professional and scientific service and the clerical. administrative, and fiscal service, the salaries of the topmost grades in each of them are identical, and in each of these 'services' certain grades, it is recognised, represent positions of equivalent responsibility, which is in each case clearly set out, and they accordingly carry salary scales with identical minima and maxima. It should further be noted that in this Act the professional and scientific service occupies the position of paramount importance.

The present-day methods of conducting the work in government departments are also, in some cases, open to grave criticism, they are productive of unnecessary duplication of effort, and consequently uneconomical In practice, the reports of the heads of the professional and technical groups are addressed to the permanent head of the department, who, however, has frequently so heavy a burden to carry that he cannot personally deal with them, and the reports therefore pass into the hands of officers of various grades in his branch. The result is, as often as not, that attempts are made by clerical and administrative officers to criticise technical details. and a lengthy and wholly unnecessary correspondence, in consequence, ensues. In those departments in which the technical work is highly complex, and the magnitude of the operations carried on in relation thereto considerable, the whole of the duplication of effort referred to would be obviated if the burden of responsibility for the details of the technical work were definitely and unequivocally placed on the shoulders of the department's chief technical adviser. In certain cases the situation could, with advantage to the public service, be met by giving the administrative chief and the chief technical adviser a co-equal status, so that, whilst carrying out their respective duties in the closest collaboration, they should at the same time be held directly responsible to the Minister each for the work within his own sphere, instead of the latter being called upon, as is at present the somewhat illogical practice, to tender his advice to the Minister through the former.

If the unequal treatment of the administrative and professional groups in the Civil Service were merely a question of a certain class of officers being dissatisfied with its status, prospects, and remuneration, the subject could be dismissed without further comment. However, the matter is one which is far more serious. Under the present organisation in the Civil Service, and the system of conducting business in government departments, it is at times impossible, much to the detriment of the public service, for the professional men to exercise effective control over professional work, no matter how expert they may be in the technique of their profession; further, a considerable waste of energy on their part is also often involved. hence the urgent need for a thorough reform in matters affecting the status of the technical expert in the Civil Service.

#### The Secrets of the Beauty Parlour.

Handbuch der gesamten Parfumerie und Kosmetik: eine wissenschaftlich-praktische Darstellung der modernen Parfumerie einschliesslich der Herstellung der Toiletteseifen nebst einem Abriss der angewandten Kosmetik. Von Dr. Fred Winter. Pp. x+947. (Wien: Julius Springer, 1927.) 69 gold marks

WHEN Hotspur quarrelled with Henry IV. he excused himself on the ground that the King's Messenger "was perfumed like a milliner, and 'twixt his finger and his thumb he held a pouncet box, which ever and anon he gave his nose and took't away again" On the other hand, readers of "Romola" will remember that whenever Tito Melema did an unusually scurvy trick, his inventor left him in the hands of his learned friend Nello the barber, to be shaved, bathed, and perfumed, presumably in the hope that these processes might do something towards his moral regeneration.

It would be unreasonable to suggest that Hotspur and George Eliot respectively represent the attitude of men and women towards the use of cosmetics and perfumes, but it is a curious fact that while men have been known to carry their antipathy to odoriferous fluids so far as to postpone a necessary visit to the barber merely to avoid them, the majority of women like these things, buy them, and sometimes use them so lavishly as to be a source of discomfort to their neighbours.

The present-day demand for these glittering wares is enormous; their illustrated slogans occupy but do not always decorate, or should we say in the modern art slang add *décor* to, the hoardings everywhere, the flapper and her too evident toilet accessories are the unfailing standby of the journalist hard up for 'copy,' and the advent of a new artist in perfumery secures much free publicity in the

press, especially in those quaint corners which editors still dedicate to 'ladies,' but which few intelligent women will admit reading. All this gives the trade in cosmetics and perfumes what Sir Lawrence Weaver might call a "smell of Babbitt," but it should be remembered that such modern necessities as soap, dentifrice, and medicinal preparations are none the worse, when their natural odour or flavour is covered, and that in this and other equally unobjectionable but less easily defined directions there is a large legitimate field for the exercise of the perfumer's art. It is primarily with such ends in view that Dr. Winter has approached his subject and compiled this book.

Nearly 300 pages are devoted to discussion of the great variety of raw materials used in the industry, and thanks mainly to copious use of constitutional formulæ for the components of essential oils, an enormous amount of information has been compressed into this space. Perusal of this section leaves the reader with the kind of feeling, which must be experienced by an intelligent artisan who has just completed a conducted tour of a contmental picture gallery—a little bewildered, but satisfied that he has had all the starred pieces pointed out to him. So breathless is the pace that towards the end the guide has only time to ejaculate such things as—benzyl propionate, smells of jasmin with a suggestion of fruit—and to sketch the It would be remarkable if the guide did not stumble occasionally, and on p. 63 he appears to confuse myristic with myristicinic acid, though it is clear elsewhere that he knows the difference between the two. Scattered through this section are practical hints, which have an academic interest for the chemist, such as the statement that mixtures of vanillin and anthranilic esters are liable to stam the skin yellow, an involuntary testimonial to the reactivity of aldehydes, and the note on p. 212 that alloxan when applied to the skin produces a pink tint, due to the traces of ammonia present in perspiration, whence it appears that the blush of the modern maiden may originate in at least two ways, physiological or chemical, the latter being due to this ingenious application of the murexide reaction. A short summary of the fermentation theory occupies less than a page, and is an excellent sample of Dr. Winter's skill in compression and his conscientious desire to leave no part of his subject untouched.

In the next section the author 'gets down' to practical perfumery and discourses on the form of cosmetic materials—distillates, creams, balsams, jellies, pastes, powders, emulsions, etc.—with

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abundant descriptions and illustrations of machinery for producing these things and pages of formulæ for the delectation of the practitioner Nor is the theoretical side neglected, for there are chapters on such fasemating subjects as the harmony of perfumes, the reaction mechanism of vapour waves, the mechanism of the mutual transformatory reactions of perfume materials, and the influence of the method of mixing on the tonality of the mixture. Writers on this subject have a habit of diverging into musical terms such as notes, tones, and harmony when mere science fails them in terminology These chapters are quite interesting, as samples of that subtle differentiation which we all find useful from time to time, though some of us are inclined to scoff at the Teutonic temperament which alone seems capable of producing it. Dr. Winter also provides a full description of modern toilet soap manufacture, written on the lines just described and including quite useful chapters on the cleansing and lathering properties of different kinds of soap. which may be commended to those who desire to find a reason for the faith that is in them regarding some particular brand of shaving soap.

The last section deals with practical cosmetics, a subject about the present position of which Dr. Winter is not altogether happy, judging from his introductory remarks on quacks and their frequent occupation of a field which belongs to the physician His discussion of the pharmacological action of some of the ingredients of cosmetics lends point to that suggestion, and, as he remarks, there is considerable danger in the indiscriminate use of such things as "eau mystérieuse," a perfumed solution of antipyrine, which on application to the skin deposits after a time a coherent coat of white powder; to theatrical artistes who must produce such effects he recommends instead a solution of phosphotungstic or phosphomolybdic acid The section is full of curious information of this kind, and is at least a remarkable tribute to the assiduity with which specialists in the art of cosmetics have ransacked scientific knowledge, and the ingenuity with which they have applied, or perhaps misapplied, it

A question asked in the House of Commons recently as to the possible dangers of the indiscriminate use of cosmetics seems to indicate that there are people who take a hygienic interest in these things. To them, as well as to those professionally interested, Dr. Winter's book may be cordially recommended as a source of accurate and recondite information, and beauty parlour specialists who can read German will find the volume a profitable investment T. A. H.

#### Social Classes and Social Welfare.

Social Differentiation By Prof. Cecil Clare North. (The University of North Carolina Social Study Series.) Pp. x +343 (Chapel Hill. N.C. University of North Carolina Press; London Oxford University Press, 1926.) 11s. 6d net.

RECENT visitor to America whose object was to see something of the teaching of the social sciences in that country was advised on landing not to omit the University of North Carolina. How long, his informant added the not conspicuously enlightened citizens of that State will tolerate the vigour and freedom of thought, especially in the dangerous region of social problems, now being displayed in their University, may be doubted. In any event, the study of the social sciences flourishes there at present. Sociologists are learning to regard The Journal of Social Forces as one of the best periodicals of its kind in any language, and to welcome additions to the series of studies to which the volume here reviewed belongs.

Prof North has made a sane and careful exammation of a problem of the first importance. His treatment is scientific. Unlike nine-tenths of those who deal with this subject, he is not the victim of any theory. The book cannot be called exciting; we have had, however, our full measure of exciting but superficial theories in sociology, especially from Europe. On the other hand, it is not ponderous, nor does it remind the reader of wading through wool, as do some of the contributions of his compatriots. What, he asks, are social differences? Why do they arise? And what is their relation to social welfare?

To the first question Prof. North replies that social differences may be divided into those of function, rank, culture and interest. Of these, those due to differences in rank are the most important. They include differences in respect to rights, privileges, or esteem, which may be personal, political, economic, religious, or honorific. These differences are the foundation of 'classes' in the strict sense, and when membership of a class is hereditary, we may speak of castes. It is perhaps a matter of doubt whether we should agree in regarding differences of interest as a separate form of social differentiation. It seems possible to resolve most of the examples here given of difference in interest into differences of function, rank, or culture. However that may be, there is clearly a close correlation between these various forms of social differentiation. A man's function will tend to carry with it a certain rank and a certain culture.

Prof North divides the factors which bring about social differences into the social and the biological. To the latter he gives full weight He thinks that slight but definite differences in intelligence exist between the average representatives of those performing various functions, and that considerable inherited differences exist between the true functioning groups on one hand and the pauper, thriftless, and criminal groups on the other. In this opinion he is probably justified. It may be remarked that this factor is becoming of greater importance. Modern society is elaborating a mechanism in the form of the educational ladder and vocational guidance whereby the young are being sifted and allocated to the functions they are most fitted to fulfil. Those engaged upon the improvement of this mechanism are wont to have us believe that there lies the path to social salvation. Everyone will be happy in his job and no one will envy anyone else, because it will be realised that those performing any given function are the best fitted for the job. This rosy picture is apt to be marred by the reflection that the capacities of the members of society may not be fitted to the functions. There may not be enough people, for example, innately suited to the routine which industry demands Account also has to be taken of the fact that inclination by no means always corresponds to capacity. All those who think themselves fitted to rule are not qualified to do so

Quite apart from these reflections, however, it may be seriously questioned whether, at least so long as rank differences persist, this biological sifting of the population is not likely to result in a dangerous segregation of the gifted members, dangerous to them and to those from whom they are separated, because there is sufficient common ground of humanity to make contact desirable, and dangerous to society because of the possible loss of the gifted through revolution or differential fertility.

Whatever may be the causes of social differentiation, its existence is of the utmost importance. Certain forms of social differentiation, chiefly those of rank, may bring unrest and sometimes revolution. For differences of rank there is little favourable to be said. On the other hand, without differences in function and culture, there is the danger of stagnation if not of decay. Functional differences may nevertheless result in unhealthy specialisation, as is the case with regard to the divorce between work by brain and work by hand to-day. The profoundly interesting study recently published by Rostovtzeff of the social and economic conditions in the Roman Empire seems to point to

the conclusion that the decay of that civilisation was due to the failure to compose differences that Prof North would call differences of rank. these led in the third century to convulsions to which an end was put by the fatal policy of the fourth century which enforced too great a uniformity.

Difficulties arising from differences of rank trouble modern society. The Russian solution seems to take the form of enforcing a uniformity which may be worse than the disease. There is no more urgent task than an examination of social differentiation in modern communities, with the object of ascertaining what differences are desirable and stimulating and what differences merely cause friction if nothing worse. Only when we have a clearer view than we possess at present of the functioning of society can we hope to apply rational control and so hope to pass beyond our present troubles.

A. M. C.-S.

### Electrons, Atoms, and Molecules.

Handbuch der Physik Herausgegeben von H.
Geiger und Karl Scheel. Band 22: Elektronen,
Atome, Molekule. Redigiert von H Geiger.
Pp. viii + 568 (Berlin Julius Springer, 1926.)
42 gold marks.

THIS twenty-second volume of the "Handbuch der Physik" is divided into six chapters dealing respectively with electrons, atomic nuclei. radioactivity, the ions in gases, size and structure of molecules, and the natural system of the chemical elements. The treatment is exceedingly clear and complete, and the twelve contributors deserve high praise both for the excellence of the subject matter and for the successful way in which they have avoided overlapping The production of the book, too, leaves nothing to be desired, and is worthy of the high standard we have grown to expect from Julius Springer. The numerous diagrams are uniform and very clear, and apart from the usual' subdivisions of the chapters and sections of the book, a useful feature is the statement at the head of each page of the actual topic under discussion A brief subject-index is given at the end of the volume, and a useful table of physical constants is included.

W. Gerlach presents, in Chap. i., an authoritative account of the various methods which have been used for the determination of the charge and specific charge of the electron, the principles and theory of each method being very clearly stated. The various results are critically discussed and the most probable values given. In his discussion of Ehren-

haft's work the author concludes that the evidence is opposed to the existence of the sub-electron

In Chap ii Kurt Philipp describes the theory and experimental verification of the scattering of a-rays in their passage through matter, as well as the scattering of \(\beta\)- and X-rays Determinations of the nuclear charge both by these methods and by the application of Moseley's law lead to the same results. This is followed by a brief account of the evaluation of the mass of atomic nuclei by the methods of J J. Thomson, Aston, and Dempster O Hahn describes the experimental work by virtue of which the identity of the a-particle with the helium nucleus was established, and Lise Meitner shows how we may gain information on nuclear structure from a study of Geiger and Nuttall's law, from the regularities observed in the emission of radiations by successive radioelements, and from the considera-The chapter closes tion of  $\beta$ - and  $\gamma$ -ray spectra with an illuminating account by Kirsch and Pettersson of work on atomic disruption by bombardment with a-particles.

The chapter on radioactivity, though brief. contains a valuable summary of the subject in its many aspects. In the section on radioactive disintegration. W Bothe describes the general theory of disintegration and the most important cases of successive change which arise in practice. We are then introduced to the work on the experimental verification of the theory, with special reference to fluctuations, and this is followed by an outline of the principal methods used in determining the main constants of radioactive change On pp 143 and 218, perhaps too much stress has been laid on the calculated heat production due to radium and its products, for although the aggregate value approximately agrees with experiment, the constituent values differ appreciably from the recent experimental determinations by Gurney and by Ellis and Wooster respectively of the values to be attributed to the B- and 7-rays

The various methods in use for detecting and measuring the activities of radioactive substances are admirably summarised by Stefan Meyer, who also deals with the preparation and main properties of each of the products in the three disintegration series, and gives a useful summary in tabular form of the constants of the radioelements. The application of the radioelements as indicators has been found of great service in a variety of chemical and physico-chemical investigations, and the results are ably summarised by O. Hahn, who also deals with the significance of radioactivity in the elucidation of problems connected with earth history. The

calculation of the influence of radioactive heat on the cooling of the earth, given on p 295, is due to Holmes, however, and not to Ingersoll and Zobel. Work on the thermal effect of potassium appeared too late to be included on p 292, and we believe that the unsuitability of thorium minerals for age determinations (p. 302) is more satisfactorily explained on the basis of a recent paper by Holmes (Phil May, vol 1 p. 1066: 1926) than by the proposal put forward in 1917 by Lawson

Chap iv contains a most valuable account of the ions in gases by Karl Przibram. After a historical introduction, an account is given of the main properties of an ionised gas, together with their theoretical interpretation. Next follows a very clear description of the different experimental methods and underlying theory for the determination of ionic mobilities, and of the influence of various factors such as pressure, temperature, and strength of field The ionic mobility in gaseous mixtures is also discussed, and reference made to the abnormally high and low mobilities obtained A section is devoted to under certain conditions the diffusion, recombination, and adsorption of ions, and the discussion of the kinetic theory of ionic constants is particularly welcome, for there are still many discrepancies between theory and experiment. Finally, after dealing with the charge, radius, and mass of ions, the chapter concludes with an account of the ionic wind, and the condensation of vapours on ions.

Karl F. Herzfeld is to be congratulated on his eminently readable and full treatment of the size and structure of molecules in Chap. v. In little more than one hundred pages the divers data are skilfully woven into a consistent scheme, and an interesting introduction is followed successively by an account of the methods used, and their results, of the position of the atomic nuclei in the molecule. and of the evidence on the structure of the electron The last two sections of this chapter are by H. G. Grimm, and deal lucidly with molecular volumes, the size of ions and its relation to ordinal number, and with atomic volumes and dimensions. To have collected together successfully material of such variety must have been no easy task, and little of importance appears to have been overlooked. Attention may perhaps be directed to the fact that in the section on thm films only one of Adam's numerous papers in the Proceedings of the Royal Society is quoted.

The concluding chapter in the book is a useful and well-written statement of our knowledge on the natural system of the chemical elements, by Fritz

Paneth. He deals in turn with periodic and nonperiodic properties, isotopy and the separation of isotopes, the distribution of the elements and atomic types in Nature, natural and artificial disintegration of the elements, and finally, with the interpretation of the experimental results from the viewpoint of the Rutherford-Bohr model of the atom.

#### Our Bookshelf.

Teaching Agricultural Vocations: a Manual for Teachers in Preparation and in Service By Prof. Rolland Maclaren Stewart and Arthur Kendall Getman Pp vii+377. (New York: John Wiley and Sons, Inc. London. Chapman and Hall Ltd., 1927.) 15s net.

This American manual well indicates the change that has taken place in the point of view of agricultural educationists in the United States. It has arisen since the passing by Congress of the Agricultural Extension Act of 1914, and the Federal Vocational Education Act of 1917, and is a wide departure from the old strictly professional and pedagogic view of adjusting and co-ordinating science and practice in agriculture.

science and practice in agriculture.

The aim of vocational education in agriculture has been well stated in these words: "It is the purpose of courses in Vocational Agriculture to aid in developing a type of American farmer who shall possess managerial ability and business capacity, an aptitude for farming and the necessary technical knowledge and skill to produce and market his products, and also one who is capable of adapting himself to our constantly changing social and economic life."

Vocational education in agriculture is a young movement, and the manual before us, intended "for teachers in preparation and in service," indicates this by the amount of propaganda it contains, especially the first six chapters, intended no doubt for "teachers in preparation." That the movement has gained ground rapidly in the United States is indicated by the Reports of the Federal Board for Vocational Education in Agriculture, which shows that the 15,453 pupils in 1918 had increased in 1926 to 108,862, a gain of more than 600 per cent. It is, therefore, not surprising with such an increase that text-books and manuals are

being published in increasing numbers

This manual is a step forward in the right direction. It takes a wide, perhaps discursive, outlook, but it is free from cut-and-dry formulæ. It covers the four types of vocational agricultural instruction as given in all-day schools, short-unit course schools, part-time schools, and evening schools. Each chapter is closed with an annotated bibliography, which is a good feature, but the index requires amplification to make it serviceable as a manual. There is one point to which exception must be taken. The responsibilities or duties of a teacher of vocational agriculture, as enumerated at pages 6-8, call for an agricultural 'Pooh-Bah.' No doubt time and experience will correct this.

To the English reader this manual will be of service for the insight it gives to the new movement in agricultural education in the United States

R Hedger Wallace

The Chemical Elements and their Compounds · an Introduction to the Study of Inorganic Chemistry from Modern Standpoints By Dr. J. A. V. Butler. Pp. xi+205. (London · Macmillan and Co. Ltd., 1927.) 68

The merits of a book on atomic and molecular structure can be judged by a very simple test. If the book merely gives an account of the personal views and impressions of the author, in the form of a long essay on valency, its value is probably not very great. but if it is written with a full sense of historic values, and is based at every point on the study of the original sources, the narrative immediately becomes of permanent value as a guide to the serious student of science

It is, therefore, a pleasure to find that Di. Butler has shown no desire to 'push' his own views on valency, but, on the contrary, has made a very successful effort to show precisely what was done by Dalton, Davy, Berzelius, Faraday, Frankland, Arrhenius, Werner, Thomson, Rutherford, Bohr, and the Braggs. In many cases he has cited the exact words of the author, and in a still larger number of cases he has shown in a diagram the apparatus that was used in those crucial tests which will be regarded in the future as 'classics' of experimental research.

As a result, the reader is able to follow step by step the logical stages by which modern theories have been suggested, tested, and established. This careful reproduction of original material has the further merit of making the book useful not only to the elementary student, who may be receiving a first introduction to theories of atomic and molecular structure, but also to many advanced students, whose second-hand knowledge of the subject may be too sketchy to be adequate

In addition to ten chapters of text and an epilogue, the book contains two appendices, the first dealing with "The Structure of Crystals," whilst the second is in the form of a "Periodic Table of the Elements, showing Arrangement of Electrons in Crystals."

in Groups."

China: Land of Famine. By Walter H. Mallory. With a Foreword by Dr. John H. Finley. (American Geographical Society: Special Publication No. 6) Pp xvi+199 (New York: American Geographical Society, 1926.) 4 dollars.

THE greater part of China's millions exist—not live—on the starvation line. The grim spectre of famine stalks about the land. "Have you eaten?" is the common salutation. Yet, in spite of wars and pestilence, floods and droughts, the population continues to multiply, and the problem of the food-supply becomes more and more insistent. The struggle for mere existence has become indescribably hard. Little wonder, therefore, that national energy is being sapped and perception dulled, and

that a race at one time in the van of civilisation has become the prey of anarchy and misrule

The author, who was attached to the China International Relief Commission, discusses in temperate but telling language the economic, natural political, and social causes of the per-manent food shortage within the country, and suggests corresponding remedies. Relief measures, he admits, are merely temporary palliatives. It is for the millions themselves to take the initiative and seek the guidance of modern science in the solution of the pressing problems of their country This implies however, the education of the masses under a stable and enlightened government, a condition which at the moment seems impossible of attainment The book ends, therefore, on a mmor key with the warning that the unhappy fate of China should be carefully studied by the great nations of the west, whose remarkable progress is also in danger of becoming assailed by the dragon of over-population.

In Ashanti and Beyond By A. W. Cardinall Pp. 288+16 plates. (London: Seeley, Service and Co., Ltd., 1927.) 21s net

MR CARDINALL has written a pleasant, readable book, full of good spirits and tempered with good sense. The author has had many years' experience in tropical Africa as a resident magistrate, and he writes mainly of his first journey and impressions This method gives a clear picture of conditions which are changing rapidly, but the observations are necessarily superficial though accurate so far as they go The book can scarcely be regarded as a contribution to anthropology, although many items of interest concerning native life, customs, and behef are mentioned, and this is to be regretted, as the author seems always to have been on excellent terms with the natives. Quite unexpected is the account of the snail industry: for the gathering curing, and selling of snails for food by the forest peoples is so well organised as to be nothing less The author states that no estimate has ever been made of their trade value, but that it must be 'colossal'. a few years ago the local chiefs forbade snailcatching for three years, for fear of complete destruction of the stock. Perhaps the most interesting part of the book is the description of the Great North Road from Kumasie which leads to "Timbucktu, the desert and to the unknown mysteries of Africa "On the whole, one learns that, in spite of flies. "the land of death" is a cheery place for a sojourn so long as there is just enough work to do.

Running, Maintenance and Repair of Diesel Engines. By Philip H. Smith. Pp. 159 (London: Constable and Co., Ltd., 1927) 3s. 6d net.

A VERY practical treatise intended for those entrusted with the operation of Diesel engine plants, particularly land installations. The first two chapters are really hors-d'œuvre, dealing briefly with the selection of the type most suitable to requirements, and with the rehability of Diesel

engines relatively to other prime movers. The index of reliability is determined from insurance claims, but the value of the conclusions arrived at cannot be assessed as the statistics are not given. It is not clear whether extent or number of claims is taken as the criterion

The real business of the book commences in the succeeding chapters, which take a comprehensive survey of the defects hable to develop during the operation of the plant. Each part of the engine is separately dealt with and its usual and possible ways of failing on service are discussed. In each case the symptoms and the probable effect of the defect as well as the measures to be taken for avoiding and for rectifying it are fully described, and in those cases where the initial cause in not obvious, a thoughtful investigation is made into the probable origin of the trouble Brief but useful notes are also given on the maintenance of proper running conditions, on indicator diagrams, and on valve setting For its size the book contains a lot of useful information Evidently the author has had a wide experience of Diesel engine operation, and the reader is given full opportunity to benefit from this valuable experience.

Abridged Callendar Steam Tables: Fahrenheit Units By Prof H. L. Callendar Second edition Pp. 8 (London: Edward Arnold and Co, 1927) 1s net

The tables are in a very useful form for the practical engineer. The properties of saturated steam are given for absolute pressures from 0.5 lb. to 500 lb. per square inch, at well-chosen intervals which do not amount to corresponding temperature differences of more than 2° to 3° F

For dry steam (superheated and supersaturated) the total heat and entropy are given, in separate tables, at absolute pressures from 15 lb. to 500 lb per square inch, the intervals corresponding to saturation temperature differences of 14° to  $22^{\circ}$  F , and superheats from  $-60^{\circ}$  to  $-400^{\circ}$  F., at intervals of  $20^{\circ}$  F. up to  $200^{\circ}$  F, and thereafter of  $40^{\circ}$  F.

A useful list of equations is given in a form convenient for reference. The tables are also published in centigrade units.

L. M. D.

Vorlesungen uber Thermodynamik. Von Prof. Dr. Max Planck. Achte Auflage. Pp. x+287. (Berlin und Leipzig: Walter de Gruyter und Co, 1927.)

Although Prof. Planck's "Thermodynamics" first appeared thirty years ago, it remains still one of the clearest books on the subject at the present day. The eighth edition has 17 sections and about 40 pages more than the first, but the sections up to 280 are numbered as before. The additional sections deal with Nernst's theorem and its consequences T is now used for the absolute temperature instead of  $\zeta$ , certain proofs formerly based on the properties of a perfect gas have been made general, and the treatment of electrolytes has been improved. The new edition is well printed, but the paper of it compares unfavourably with that of the first edition.

#### Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. No notice is taken of anonymous communications]

#### The Radioactivity of Potassium.

THE work of Aston has shown that potassium, which has an atomic weight of 39 104 (Honigschmid), is a mixture of two isotopes. The atomic masses of these are 39 and 41, and they are present in ordinary potassium in the proportion of 20 to 1 respectively. Potassium emits a fairly penetrating 3-radiation, and we are led to inquire as to which of the isotopes is responsible for the emission of  $\beta$ -rays. It may be that there is a third isotope present in potassium, but in such small amounts that its detection by the mass spectograph is impracticable. Such a possibility has been discussed by Harkins (Proc. Nat. Acad. Sci., vol. 11, p. 630; 1925), who considers that isotopes of mass  $4\bar{0}$  or 41, the former of which is unknown, are the ones most likely to be radioactive. Harkins considers the hypothetical isotope of mass 43 (Kossel: Phys. Zert., vol. 20; 1919) to be less probable.

We can arrive at a solution of the problem by carrying out a partial separation of the isotopes of potassium and examining the activities of the frac-tions obtained. By way of illustration we may suppose that such a partial separation leads to a concentration of the isotope 41, and that the atomic weight of the 'heavy' fraction is found to be 0 005 unit greater than that of ordinary potassium. The obvious conclusion from such a result would be that whereas ordinary potassium contains 520 per cent. of potassium 41, the 'heavy' fraction contains 545 per cent. of that isotope. If the radioactivity of potassium is to be ascribed to the isotope of mass 41, we should then expect to find that the activity of the 'heavy' fraction would be 48 per cent. greater than that of ordinary potassium. Should the activity be due to a hypothetical isotope of mass 43, the difference in activity would be  $\sqrt{2} \times 4.8$  per cent. On the other hand, if the activity be attributable to the chief isotope of mass 39, we should find that the heavy fraction would be 0.2 per cent. less active than ordinary potassium.

Shortly after they were successful in effecting a partial separation of the isotopes of mercury and of chlorine, by the method of ideal distillation, Brønsted and the present writer undertook an elaborate research on the separation of the isotopes of potassium. After several unsuccessful attempts the work was discontinued, as we were engaged on other more pressing problems. It was taken up again later by one of us (G. H.) in collaboration with Miss Løgstrup.

About one litre of molten potassium was introduced into the first of a system of Pyrex bulbs connected to a high vacuum. By means of an electric heater and an asbestos cylinder containing carbon dioxide snow the potassium could be distilled from the lower to the upper half of the bulb, and in this way repeated distillations were carried out, the apparatus being maintained at a high vacuum all the time. The later operations of ideal distillation were performed in the succeeding bulbs, the carefully purified liquid potassium being heated to about 160° C. and the cooled potassium surface on which condensation was to take place being cooled by solid carbon dioxide. It was arranged that the distance between the bot and cold surfaces was maintained at less than

1 cm. After each operation of ideal distillation about 1-2 cc of potassium residue remained, and this was transferred (in vacuo) to the next bulb. This operation was repeated ten times, and the whole of the residual heavy fractions were collected together so as to have ample material for an atomic weight determination. Full details of the distillation

process will be published elsewhere

Prof. Honigschmid kindly undertook to determine the atomic weight of the residual heavy potassium fraction, and for this he found an atomic weight 0 005  $(\pm 1)$  unit in excess of that of ordinary potassium. It was now necessary to compare the activity of the heavy fraction with that of ordinary potassium Owing to the feeble radioactivity of potassium great difficulty was experienced in obtaining a sufficiently high insulation of the  $\beta$ -ray electroscope to ensure an exact comparison of the two activities, and ultimately it was decided to abandon this method in favour of the Hoffmann vacuum electrometer. Through the courtesy of Prof G Hoffmann the measurements were carried out in his laboratory at Konigsberg The difference between the activities of the heavy potassium fraction and ordinary potassium was found to be  $4.2\pm0.7$  per cent. In each case the material was converted into potassium chloride for the purpose of measurement. This result is in good agreement with that to be expected from the observed change in atomic weight, on the assumption that the activity of potassium is due to the isotope of mass 41. We are thus led to the conclusion that the potassium isotope 41 is mainly if not solely responsible for the observed radioactivity of potassium.

If we make the assumption that in the case of rubidium the activity is also due to the heavier of the two isotopes 85 and 87, we get a simple general explanation of the greater intensity of the activity of rubidium as compared with potassium. The heavier isotope is four times more strongly represented in rubidium than in potassium, and hence the tota activity of rubidium is approximately four times that of potassium. On the other hand, cassium is a pure element, and the absence of radioactivity in the case of this element can readily be explained by similar reasoning, as suggested by Aston some time ago (Ann. Rep. Chem. Soc., vol. 21, p. 258; 1924)

According to Holmes and Lawson (NATURE, vol. 117, p. 620; 1926) the most probable half-value period of potassium is  $T_{\rm K}=1~5\times10^{12}$  years. This value was obtained on the basis of very careful and detailed considerations of the relative  $\beta$ -ray activities of potassium, rubidium, and uranium, and by assuming that both the isotopes 39 and 41, 1e. the whole of ordinary potassium, are radioactive. Should the radioactivity be confined to the 41 constituent of the mixed element, it was shown that the half-value period of the isotope of mass 41 would be  $7.5 \times 10^{10}$ years (Holmes and Lawson: Phil. Mag., vol. ii. p. 1224; 1926). Now it has been shown above that the radioactivity of potassium is to be ascribed to the isotope 41, so that the latter figure for the halfperiod is the true one. Radioactive measurements give no indication of the period of the common potassium isotope of mass 39, and this does not appear to differ from other stable elements in respect of its radioactivity.

The above conclusions in no way affect the interesting results obtained by Holmes and Lawson (Phil. Mag., l.c.) on the radioactivity of potassium and its geological significance. From the calculated period of potassium 41 it follows that since the consolidation of the earth's crust about 2 per cent. of this isotope will have disintegrated, and we are led to the conclusion that at that early stage of the earth's history

the atomic weight of potassium would be 0.002 of a unit higher than it is to-day. Should they lack other methods, chemists of the very distant future will be able, by redetermining its atomic weight, to calculate the lapse of time since the first modern atomic

weight determination of potassium.

If we assume that the emission of 3-particles effects an alteration in the nuclear charge, the product of transformation of potassium will be a calcium isotope of atomic weight 41. We have seen that since the consolidation of the earth's crust about 2 per cent. of potassium of mass 41 will have decayed, so that the maximum amount of calcium 41 which has accumulated in potassium minerals during the whole of geological time will amount to only 0.1 per cent. of their potassium content. This should be capable of detection in determinations of the atomic weight of calcium which has been extracted from old potassium minerals.

G. Hevesy. (Institute of Theoretical Physics, University of Copenhagen ) Institute of Physical Chemistry, University of Freiburg (Baden).

#### Theory of the Upper Atmosphere and Meteors.

IT has been clearly recognised that the force of gravity acting on the atmosphere of the earth will cause the heavier gases to settle downward by diffusion and the lighter gases to rise to the higher altitude, and that winds, if they exist, would by convection keep the composition of the air uniform at all elevations. The classical ideas of atmospheric pressures (for example, Humphreys, Jeans, Chapman, and Milne, etc ) have been based on the assumption that convection is negligible, at least above a 50 km level, and that diffusion is the important factor in determining the partial pressures of the gases. In this note are presented some conclusions, to be published in detail later, which have resulted from taking into account convection and diurnal temperature variations in the high atmosphere.

The ordinary equations of diffusion show at once that if the air were uniformly mixed at all altitudes and then left free from all convection currents, there would be a constant flow of lighter molecules upward and of heavier molecules downward, which would be independent of the altitude until a level was reached where the diffusing gas would be in gravity equilibrium. This 'diffusion' level for hydrogen would move from infinity down to 142 km. in one day, at the end of five days it would be at a height of 127 km., and in 50 days it would be at 113 km. The corresponding levels for helium would be at 137, 120, and 106 km respectively. The new calculations give hydrogen and helium contents above 150 km roughly 1/100,000 of

the values previously calculated.

Absorption of solar and terrestrial radiation must be taken into account in any discussion of radiation equilibrium in the upper atmosphere. Numerous writers have recognised this fact, but apparently none of them has made an attempt to calculate absorption coefficients or to estimate a difference of temperature for day and night, or winter and summer conditions. Water vapour above II km. absorbs a little more than 20 per cent. of black body radiation from below at earth temperatures, while carbon dioxide absorbs nearly 40 per cent. Ozone absorbs only about 2 per cent., but its presence is important because it absorbs about 4 per cent. of the solar radiation at an altitude where most of the re-radiation must be by the ozone itself. Temperature calculations based on these absorption coefficients show that for a 50° latitude above a height of 60 km. we should expect a temperature of about 250° K. during a winter day with a drop to 220° during the night, and a temperature of 370° during a summer day with a corresponding drop

to 230° during the night

The atmosphere at the base of the stratosphere cannot be in radiation equilibrium, but must receive more radiant energy than it loses both from above and below during a 24-hour day. The temperature condition of the earth's surface is in very unstable equilibrium. The loss in heat by radiation from the warm equator is much less than from the cooler polar regions. An increase in temperature at sea-level near the equator would not result in an increase in the energy lost by radiation from these regions, but would actually result in a decrease. Loss of heat by radiation from the earth depends not on the condition of the surface, but on the temperature at the base of the stratosphere and absorption in the stratosphere A slight change in the carbon dioxide of the air would have a tremendous influence on the climate of the earth. If the carbon dioxide content of the air were increased from the present 0 03 per cent to 0 I per cent., tropical plants would probably grow in the polar On the other hand, if this protecting sheet decreased from 003 per cent. to 001 per cent., ice would probably be found near the equator.

Since the present theory leads to low densities of the atmosphere above heights of 100 km. or so, densities much lower than those of classical tables, the facts about the appearances of meteors require explanation. It seems possible to do this following to a certam extent the ideas of Sparrow and departing from those of Lindemann. When a high-speed meteor strikes an air molecule, it is assumed that the energy of the impact violently ejects atoms, molecules, and possibly small particles of molecular dimensions from the body of the meteor This ejected material, by virtue of its velocity, carries into the air the energy which eventually gives the light of the meteor trail. For example, when a nitrogen molecule strikes an iron meteor which has a velocity of 40 km. per second, the energy of the impact is sufficient to raise the temperature of 1800 molecules 1000° C., or to evaporate 56 molecules of iron, or to evaporate and ionise 24 molecules of iron. As a result of this impact, a mass roughly thirty times that of the nitrogen molecule is ejected from the meteor principally in the form of highly energised iron atoms which have velocities slightly greater than that of the meteor itself. The melastic collisions of these iron atoms with the molecules of the air result in the visible trail

The excitation energy of these collisions may be as high as 155 volts for nitrogen or 280 volts for argon. Much of this energy may be radiated in the ultra-violet or even soft X-ray region, and it is probable that not more than one-tenth of the total radiation is in the visible part of the spectrum Therefore, the total mass of the meteor must be much more than that derived by Lindemann and Dobson from their considerations of the relation between the mass of a meteor and its light. The temperature changes in the upper atmosphere from evening to morning, and from winter to summer, given by the present theory, lead one to expect appearance of meteors at heights which are greater by, say, 5 km. in the evening than in the morning, and in the summer than in the winter. It would be interesting to know whether this difference has been observed.

H. B. MARIS.

Naval Research Laboratory, Washington, D.C., Oct. 8.

#### Descent and Divergence.

IN Sir Arthur Keith's presidential address to the British Association at Leeds (Supplement to Nature, Sept 3, 1927), reteience is made to "the zigzag line of man's descent." It seemed desirable, if possible, to have some graphic method of crystallising, as in a nutshell, the views of the present moment as deduced from the results attained by leading investigators in this field. To that end the adjoining chart (Fig. 1)

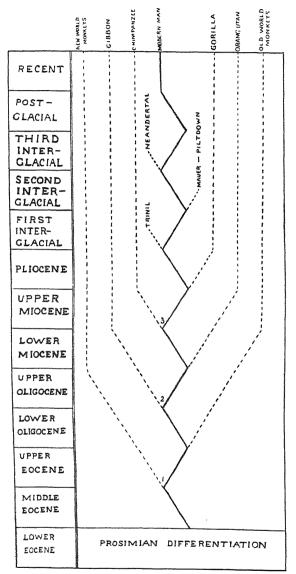


Fig. 1.

may be found useful, and a few words in justification

of it may be permitted.

In one of the best osteological diagrams ever devised, T. H. Huxley portrayed a procession of anthropoids as "a single file of skeletons" from gibbon to man. Needless to say, he did not intend to suggest a simple series of transformations such as a mere glance at the illustration might mislead one into supposing, but to demonstrate, like Pierre Belon's parallel figures of the skeletons of bird and man published in the middle of the sixteenth century, the

unity of plan of composition of these beings. Of course he knew that no zoological gradation of recent forms coincides with their geological succession. In the same mimitable essay ("Man's Place in Nature," 1863) there is a series of sections of the skulls of man and various apes "drawn so as to give the cerebral cavity the same length in each case, thereby displaying the varying proportions of the facial bones."

In the annexed chart the geological time-intervals are reduced to the same duration in order to bring out the corresponding evolutionary impulses which may be imagined to have stirred the nascent stocks to climatic fitness during those strenuous periods. Each stage advanced in a certain direction until what Prof. J. Arthur Thomson has aptly termed a strain-limit' was reached; the human way then became diverted to a new trend, while the simian strain continued along 'the lane that had no turning.' Some of the causes which were at work in effecting the first or platy-catarrhine divergence are sufficiently obvious, and it is interesting to find continental division joining forces with morphological divergence. The next parting of the ways, indicated on the chart, may be distinguished as the satyrine, and the third as the troglodyte divergence. These are milestones ın human descent.

The censure which such a speculative chart justly deserves would be instructive should the line it takes become known.

ARTHUR WILLEY.

McGill University, Montreal, Canada, Oct. 17.

#### Association in Liquids.

The following seems to be a possible means of investigating the question of association. Without going into the experimental and mechanical difficulties, which are great but not insuperable, I will indicate briefly the general idea, and for that purpose will take the simplest optical system of several that might be used.

Consider a liquid contained in a tubular cell which is closed at the top by a semi-platmised plate and by a mirror at the bottom; with proper adjustment we shall observe a system of interference rings centred about the vertical axis of the cell

Let the cell be mounted as a centrifuge and be fitted so that the speed of rotation, which is to be completely

controllable, is known.

It is clear that on rotation there will be a movement of the rings across the field of view. Assuming that both the number of rings and the rate at which they pass can be noted, we get a complete insight into the changes in the 'optical density' of the liquid.

Knowing the speed of rotation and the compressibility of the liquid, we can calculate its bulk density at

any point on the radius of the cell.

There are three cases to be considered.

(1) With a pure unassociated liquid we may take it that the calculated bulk density is reached practically instantaneously, so that even while the speed is changing it will coincide with the optical density.

(2) With a dilute solution the two densities will no longer coincide. The compressing effect will, as before, be instantaneous, but the difference between the two densities will, while the speed is changing, be dependent on the osmotic pressure and the rate of diffusion of the solute. Obviously the slower the rate of change of speed the less the discrepancy. When the steady state at any constant speed has been reached, the difference will be a measure of the concentration of the solute.

Thus it would seem that a solution can be distin-

guished from a pure liquid by seeing whether the rings continue to move after the constant speed is reached.

(3) With concentrated solutions, the effects are more complicated, but they need not concern us here

Now it is easy to show that an associated liquid is but a special case of miscible liquids, and as such is subject to all the osmotic laws. If we select a liquid which is but slightly associated it would come under category (2), and, on centrifuging, the two sets of molecules would, in general, be temporarily separated; and if we know from other sources their relative concentration, valuable light on the type of association might be obtained

It may be pointed out that the sensitiveness of the method is, among other things, proportional (approximately) to the depth of liquid under examination: thus using a long column and a suitable optical system it might be possible to separate isotopes which are not

otherwise separable.

As bearing on the whole subject I would direct attention to a paper by the late Dr. C. V. Burton and me on the "osmotic theory of solutions" (Phd. Mag., 1909.

ment between the term values (see Table I.) of certain band groups of the many lined spectrum of H<sub>2</sub> which he analysed (*Proc. Roy. Soc..* 113, 400, 1926) and the triplet system of the atomic helium spectrum. In the case of He<sub>2</sub> and H<sub>2</sub> the analogy can be carried further in detail, due to the fact that under the usual conditions of excitation the band groups of the triplet system of He<sub>2</sub> ('Main-series') and the corresponding groups in the many lined spectrum of hydrogen (Fulcher bands, etc.. see *Proc. Roy Soc..* 113, 368; 1926) appear in greater intensity than the band groups of the singlet system of He<sub>2</sub> ('Second series') and the corresponding groups of the many-lined spectrum of H<sub>2</sub>. Furthermore, there appear relatively many lines in the *Q*-branches of the band spectrum of He<sub>2</sub> and in the many-lined spectrum of H<sub>2</sub>, while the *P*- and *R*-branches fade out with comparatively low rotational quantum numbers.

Table I. gives a summary of the arrangement and magnitude of such of the electronic terms (in effective quantum numbers) of the spectra of He<sub>2</sub>, He, and H<sub>2</sub>

as have been analysed.

The existence of the well-known 23S state in the

Table I.
Observed Effective Quantum Numbers of Electronic States in Helium and Hydrogen.

	Triplet System				Singlet System.										
1	He <sub>2</sub> -Molecule		He-Atom.		H <sub>2</sub> -Molecule		He2-Molecule		He-Atom.		H <sub>2</sub> -Molecule				
i	S	P	D.	S	P	D	S.	P	S	P	S	Р.	D	S	P
1 2 3 4 5 6	1.788 2.810 3.818	(1 928)* 2 928 3 928 4 928 5 927 etc	3 013 :: ::	1 689 2 697 3 700 4 701	1 937 2 933 3 932 4 932 etc	2 997 3 997 4 997	1.934	(1 928)* 2 937 3 939 4 941 5 941 etc.	0 744 1 853	2 964 3 965 4 966 5 964	0 744 1 850 2 857 3 858	2 009 3 011 4 011 etc.	2 998 3 998 	0 919 1 919 (2 920)*	1 695 (2 695)*

\* Calculated.

p. 598; there are printer's errors on p. 612), which may help in the matter; indeed, the optical method indicated above was devised by us so as to continue the centrifuging experiments mentioned therem; but I am not in a position to pursue the research any further.

Since writing the above I have seen Messrs. Raman and Krishnan's letter on "The Maxwell Effect in Liquids" (NATURE, Nov. 19). It would be interesting to see whether the 'optical' centrifuge could be used to test their theory; if, however, it takes time for asymmetric molecules to orient themselves, it will be difficult to distinguish between this effect and that caused by association.

BERKELEY.

Berkeley Castle, Gloucestershire.

# Absorption Experiments on Excited Molecular Hydrogen.

RECENT investigations on the band spectrum of helium and the many-lined spectrum of hydrogen seem to show that there is a far-reaching analogy between the arrangement and location of the electronic states of the term systems of the spectra of He, He<sub>2</sub>, and H<sub>2</sub>. For the spectra of He and He<sub>2</sub> this analogy has been discussed by Mullikan (*Proc. Nat. Acad. Sci.*, 12, 158; 1925) and extended by the author (*Proc. Nat. Acad. Sci.*, 13, 213; 1927). In regard to the correspondence between the electronic states of He and H<sub>2</sub>, Richardson demonstrated a remarkable agree-

helium spectrum, and the fact that intercombinations between the triplet and singlet systems mentioned in Table I. have not been observed (except for the combination \ 591 56 found by Lyman in the helium spectrum, which he classifies as the transition  $1^1S_0 - 2^3P_1$ ) led ine to look for a corresponding metastable state of  $H_2$  by absorption experiments in excited molecular hydrogen. The experimental conditions in the emission tube were chosen so as to produce the many-lined spectrum in particular. In the absorption tube a weak electric excitation of the hydrogen gas was used in order to excite any existing metastable states, that these might be the initial states of absorption for the radiation of the  $H_2$ -molecules in the emission tube. If there is any absorption it should be shown by self-reversal of certain band lines.

The absorption measurements which have been made over the whole region of the visible many-lined spectrum seem, indeed, to have the expected result. A number of intense lines, which are not distributed over the whole spectrum but are located in definitely bounded regions, distinctly show self-reversal, while other intense lines scattered over the whole spectrum do not show any absorption. The study of the series relations of the reversed lines is in progress. After further experiments the results will be published elsewhere in detail. It is intended to extend the absorption experiments to excited molecular helium.

L. A. SOMMER.

Jefferson Physical Laboratory, Cambridge (Mass.), Sept. 30.

#### Oxide of Fluorine or Fluoride of Oxygen?

THE ISSUE OF NATURE OF Nov. 5, p 672, contains the news of a very important discovery made by Messrs. P Lebeau and A. Damiens and communicated to the Paris Academy of Sciences on Oct. 3 (see Comptes rendus, pp. 652-654, 1927). In the preparation of fluorine by the electrolysis of the acid potassium fluoride, it was noticed that at the commencement of the operation, owing to the presence in the liquid of a small quantity of water, a new gas was obtained of which the formula has been established as F<sub>2</sub>O, probably a monoxide of fluorine. In my view the new gas is not a monoxide of fluorine, F2O, but a difluoride of oxygen, OF2 The two formulæ are by no means identical, and it is interesting to note that a famous investigator like Prof. Lebeau has overlooked the true state of the matter, for he says that it is  $OF_2$  (i.e. our  $F_2O$ , but he places the negative element first!) "paraissant être plutôt un oxyde qu'un anhydride."

Having been brought up on the electrochemical theory of Berzelius, I always regarded the chemical elements from the point of view whether they are, more or less, electropositive or electronegative—a point of view which was not accepted by my great teacher Mendeléeff (see Ostwald's "Klassiker," No 68, p 60)—and I was much gratified when Arrhenius in his electrochemical theory appeared as a Berzelius redivivus.' As regards the second series of the Periodic System or Classification of Mendeléeff (it was formerly called 'Law' in England, but the denomination 'Table' seems to me to be inadequate for a brilliant, fundamental, theoretical idea!) this series begins with a strongly electropositive element, lithium, and ends with the most negative of all elements, fluorine, thus:

#### + Li Be B C N O F - (Ne).

All the first five elements form oxides in which they are positive and the oxygen negative, and even ozone may be regarded as an oxide of (+quadrivalent) oxygen. But it was pointed out by me alone, in my lectures more than thirty years ago, in my introduction to Mendeléeff's Periodic System, 1907, and in Abegg's "Handbuch," vol. iv. 2, p. 2 (with Auerbach, 1913), that fluorine cannot form oxides, hydroxides, or oxy-acids, because it is more negative than oxygen. At the utmost a fluoride of oxygen  $(O +) (F -)_x$  could exist. Indeed, this is the new gas discovered by Lebeau and Damiens . OF<sub>2</sub>, not F<sub>2</sub>O. The difference between the two formulæ is best seen on representing how the electrons pass from the positive to the negative atom :

The first formula is impossible, the second, third, and fourth are analogous. As the inner constitution of the difluoride of oxygen, OF<sub>2</sub> is different from that of the chlorine monoxide Cl<sub>2</sub>O, it is easily understood that their chemical and physical properties will not be analogous.

It may be that a trace of this gas, possessing a peculiar odour, different from hydrofluoric acid or fluorine, was formed when I treated the new double oxide Pb<sub>5</sub>O<sub>7</sub>. 3H<sub>2</sub>O with concentrated hydrofluoric acid (Manchester, 1881).

BOHUSLAV BRAUNER

Bohemian Academy, Prague, Nov. 8.

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#### Winter Thunderstorms.

In January last an appeal was made for reports of any thunder or lightning which might be observed before April 1, 1927 (Nature, 119, Jan. 22, 1927, p. 123) The census of storms was carried out in conjunction with the Meteorological Office, and efforts were made to obtain the co-operation of observers in all parts of the British Islands. Considering the whole of the six months from October 1926 to March 1927, thunderstorms occurred somewhere in the British Isles on 96 days out of 182 Details for the individual months are given in the following Table:

	England	Wales	Scotland	Ireland	British Isles	
1926						
October .	16	11	10	9	21	
November .	18	11	10	12	20	Ì
December .	5	1	4	0	8	l
1927						ľ
January .	14	8	16	14	23	
February .	6	1	3	2	7	1
March .	14	5	3	7	17	1
						-
Total (six months)	73	37	46	44	96	

In England and Wales there were five prominent stormy areas, namely, Sussex and Surrey, Devon and Cornwall, the Severn valley, south-west Yorkshire and the Lake District. In Scotland and Ireland the central portions of the west coasts of each country were particularly disturbed. Similar features have been noticed in previous winters. A lane of no storms ran from Dorset to the Wash, and large portions of the northern English counties were also free from storms.

Considering the first three months only of each of the past five years, 1927, 1926, and 1924 were comparatively free from thunder, while 1925 was

particularly stormy

The investigation is being continued during the present winter, and I shall again be very grateful for reports of any thunder, lightning, or hail which may be observed by readers of NATURE before April 1, 1928. A note of the place, date, and time of the occurrence, with the direction in which the lightning was seen, especially at night, will be very valuable. Any additional information of the following character will, in the case of actual thunderstorms, be extremely welcome. (1) The time when the storm passed overhead, or was nearest, with its direction; how long it lasted; (2) severity of storm, much or little thunder or lightning; (3) whether accompanied by hail, rain, or snow; (4) direction and strength of wind; change of wind (if any); (5) whether there was a change in temperature during the storm. S. Morris Bower.

Langley Terrace, Oakes, Huddersfield, Nov. 19.

#### Science and Survival.

In an article on page 613 of NATURE for Oct 29, headed "Science and Survival," the reviewer of a book called "The Bridge" asks certain pertinent questions which deserve an answer. Unanswered, they may suggest to a student of the book erroneous hypotheses which will lead him astray. I appreciate the fairness of the review: my object is only to furnish the additional

information virtually asked for, in the interests of truth

First, then, as to the identity of "a man in Cardiff," who might be erroneously regarded as a concealed source of normal information. This unspecified gentleman, I now find, is willing to give his name in confidence to the editor and to the reviewer; who will thus see that he is a responsible person, and emphatically not the kind of man who would give information to mediums, or attempt to spoil an experiment. As a matter of tact, he was not aware of the experiment until it was over; he never saw or communicated with Mrs. White at all after it had been planned. He was a mere initial incident, and to bring him into the matter would be to follow a false scent.

Next concerning Damais Walker First, if she had not happened to be living with her sister, unoccupied at the time, and therefore with leisure to try to develop her psychical faculty, the experiment on which the case is based would not have been started Secondly, the information she gave was not, when she gave it, known to anyone in the house; nor was it readily ascertainable by inquiry. The music-room, for example, had not been decorated and arranged, as described, since Mrs. White had got into touch with Nea Walker. Thirdly, the descriptions given by Damaris Walker were not returned upon and amended afterwards; each record was complete and done with, before it was annotated by a survivor and so verified as correct.

The reviewer duly appreciates and directs attention to the difficulty involved in selection of incidents. I have had an opportunity of seeing the whole, and am able to assert strongly that no omission has been made in order to strengthen the case. Selection was necessary solely because of comparatively irrelevant or only distantly related matter, referring to "the group" and other people. It was difficult to determine how much to include and what to cut out. Advice of experts was taken, and the book thus kept within reasonable limits; but never was a weak point intentionally omitted.

OLIVER LODGE

Normanton House, Lake, Salisbury, Nov. 26.

#### The So-called Viscid Secretion in Spawning Oysters.

In literature dealing with the Flat or European oyster, O. edulis, the statement is frequently made that when the eggs are spawned into the mantle cavity they are held together there and fastened to the gills by a white viscid secretion There is no doubt that this statement is incorrect and that what has been described as a white viscid secretion is an extrusion of blood-cells entangled in mucus. In a fairly recent publication (Fish. Inv., 3, 1923: London, 1924) I have shown that when oysters are taken out of water—and especially when transported or retained out of water some time—in hot weather, an extensive diapedesis, or 'bleeding,' occurs Now a large proportion of white-Now a large proportion of whitesick oysters, even after lying on a bench some hours, in the breeding, that is, warm, season, begin to 'bleed' more or less, in relation to the temperature and time out of water; further, many oysters spawn at the instant of dredging or after being taken out of water, and in such cases heavier bleeding than usual is liable to occur. It is, however, possible that a certain amount of—but not necessarily extensive—bleeding does normally occur at the act of spawning.

The concurrence of bleeding at or after the spawning act has given rise to the view that the embryos are actually fastened to the gills. In the course of

recent work (Jour. M B.A, 4, 4; 1927) it was necessary to examine oysters, immediately after they were dredged, either on the foreshore or in sheds adjacent to the dredging boats. In a few cases individuals were found with eggs in a fertilised but unsegmented condition, that is, just spawned. In these critical cases there was no viscid secretion, nor was there any in these circumstances in a large percentage of cases where the embryos were white but in various stages of segmentation later than the 2-celled condition. Moreover, when a secretion of this kind is present, it generally occurs in isolated masses, and does not encompass the whole of the embryos.

The so-called viscid secretion is, therefore, a mass of blood cells entangled in mucus; it is formed when oysters are kept out of water in warm weather as a result of diapedesis. The blood cells are sloughed off the gill in mucus in variable quantities, sometimes in great numbers, and a variable number of embryos may also become entangled in the mucus, but the number of embryos so entangled is usually relatively very few. The cause of diapedesis in oysters is no doubt capable of an exact physical expression, which, however, still remains to be found.

J. H. ORTON.

Marine Biological Laboratory, Plymouth.

## An Unrecorded Constituent of Commercial Ethyl Ether.

For anæsthetic purposes a pure diethyl ether is now generally recognised as a desideratum. An opportunity recently arose for carrying out some experiments on the bromine absorption of commercial anæsthetic ethers, a standard solution of bromine in glacial acetic acid being added, and light excluded to avoid direct substitution of the ether by bromine. The products from six manufacturers absorbed bromine to different extents, as is shown by the following figures .—A, 06, B, 25; C, 7.5; D, 116; E, 136; F, 15 9. These are the numbers of c.c. of deci-normal bromine absorbed by 100 c.c. of the different ethers in the dark in one hour, which in the absence of aldehydes give a measure of the degree of unsaturation of the ethers On examination of the bromination products of 2250 cc. of ether C, among other constituents which are being further examined there was identified, as a major product, αβ-dibromovinylethyl ether (1 gram), which must have arisen from vinylethyl ether, CH<sub>2</sub>: CH<sub>2</sub>: CH<sub>3</sub>, b.p. 35°·5, present in the original ether. Vinylethyl ether was also present to a similar extent in freshly prepared ether, direct from the manufacturing still, which had never been exposed to light. It doubtless owes its origin to vinyl alcohol (acetaldehyde) functioning in the same way as ethyl alcohol in the Williamson process.

The instability of vinylethyl ether to acids with production of acetaldehyde is on record, but it also develops aldehyde on storage without acid and reacts towards Schiff's and Tollens' reagents as an aldehyde

The question as to whether vinylethyl ether is the first product of the action of light on diethyl ether as postulated by Wieland is receiving attention. It may, however, be recorded that an old sample of solvent ether which was rich in peroxides—equivalent to 5.6 gm. of hydrogen peroxide per litre—contained a small amount of vinylethyl ether, as was shown by isolation of its bromine addition product.

HAROLD KING.

National Institute for Medical Research, Hampstead, N.W.3, Nov. 18.

#### The Glaciers of Dauphiné.1

N NATURE of Mar. 27, 1926 (vol 117, p. 456), an account was given of the important glaciological work carried on by the French Direction Générale des Eaux et Forêts on the principal glaciers of the chain of Mont Blanc A further volume of results has now been published relating to similar work on the glaciers of the Alps of Dauphiné, those descending from the great peaks de la Meije, les Écrins, and Mont Pelvoux It will be remembered that the principal glaciers in question are as follows On the north of the Meije group of peaks, facing the Romanche valley, in which is situated La Grave, there are the glaciers de la Meije, de Tabuchet, de l'Homme, de Rateau, du Lac, de la Girose, and du Mont-de-Lans; on the south side, facing the valley of Vénéon, is the glacier de la Selle, from the north-east and north-west flanks of les Écrins respectively descend the glaciers Blanc and de la Bonne Pierre, and between les Écrins and Mont Pelvoux, north of the latter, the glacier Noir, while from Mont Pelvoux and its flanking companion peak the Ailefroide descends on the west the glacier de la Pılatte

All these glaciers have been under observation, survey, and accurate measurement since the year 1911, and some of them since 1909, with the exception of the two first War years, 1914 and 1915, right up to the present time, the report giving the results up to 1924. In addition, the glaciers of the Grandes Rousses group, north-west of the Meije-Écrins-Pelvoux chain, those of Saint Sorlin, des Quirlies, des Malâtres, du Grand Sablat, de Sarennes, and des Rousses, have also been observed.

From the commencement in 1909, when the glaciers de la Selle, de la Girose, and du Mont-de-Lans were studied, it was obvious that the period of retrogression, hitherto for many years so obvious, was coming to an end, if it had not actually terminated, so that the time chosen for this great survey of glaciological movement was most propitious. The official observers of the Département des Eaux et Forêts had the advantage of the collaboration of Profs Blanchard and Flusin of the University of Grenoble, and of Prof. Bénévent of the École Supérieure

The first results obtained in 1909 showed that while the glacier de la Selle was still very slightly in retreat, the Girose and Mont-de-Lans glaciers had really begun to advance, the snout of the last-mentioned glacier being thrust forward nine metres beyond its position in 1908. Moreover, the general appearance of both glaciers had changed enormously, much of the ground hitherto left bare at the sides during the retreat having been recovered. When observed again in the summer of 1910, a very stormy year of great snow blizzards, all three glaciers showed a clear advance.

In 1911 the observations were extended to the glaciers de la Meije, du Lac, du Rateau, and the six

1 "Ministère de l'Agriculture: Direction générale des Eaux et Forêts." 2º partie: Eaux et Génie rural. Service des Forces hydrauliques. Études glaciologiques. Tome 6. Pp ii+179+16 planches. (Paris: Ministère de l'Agriculture, 1927.)

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glaciers already named of the Grandes Rousses, and the advance found to be general, a clear frontal (snout) advance of all the glaciers being revealed by the measurements, together with a great augmentation of the upper snowfields and névé. The next summer, 1912, was very wet and cold, and avalanche residues persisted to quite an unusual extent, so that the snow augmentation above, on, and about the glaciers was very remarkable.

In 1913 the observations were further extended so as to include the glaciers de la Pilatte (the Refuge Carrelet above La Berarde being the base of operations) and de la Bonne Pierre, and similar advances with all were observed, except in the case of the last-mentioned glacier, which still showed a slight retreat

The War at first prevented the regular continuance of the work, but happily means were found in 1916 to recommence the observations By this time all the Dauphiné glaciers had advanced considerably, even the Bonne Pierre having thrust its snout forwards by ten metres The glacier de la Selle had so greatly enlarged that all the stakes (jalons), ladder-scales, and other fiducial marks were totally buried and lost; and the avalanche snow from the Col de la Lauze (the well-known glacier pass at the head of the Girose glacier, by which one passes over from La Grave to St Christophe on the Le Berarde road) had so accumulated on the St. Christophe side over against the de la Selle glacier as to have obliterated completely the medial moraine of the latter. The 1917 observations also afforded similar results, but without the exceptional snow deposits.

The general advance of the Dauphine glaciers at this time is more remarkable than that referred to in the previous report on the Mont Blanc glaciers, inasmuch as the precipitation is much less than that occurring in the Chamonix district. At La Berarde, for example, the average is only half what it is at La Tour at the northern end of the Chamonix valley In the summer of 1918, however, it began to look as if the advance were only a secondary one, and not to be compared with the great advance of the seventeenth century, which began in 1580, or the later one which showed its maximum in the beginning of the nineteenth century. For the growth had slackened or ceased in many cases by 1918, although some of the glaciers still showed a clear advance, for example, the glacier de la Bonne Pierre and the glaciers Blanc and Noir, which had now come under observation and had exhibited a thrust of snout forwards by so much as ten metres each The year 1919 was a great snow year, so much so that the glaciers and their moraines were too much snow encumbered to enable any valuable conclusions to There were two exceptions, howbe drawn. ever, for the glaciers de la Meije and Tabuchet showed very clearly increases in length of no less than seventy and thirty-five metres respectively, and the Meije had also thrown up a new moraine ten metres high. By 1921, nevertheless,

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retrogression was manifested, the Girose glacier having retreated six metres since 1919, the Meije nine metres on one tongue of its snout and thirty on the other, the Rateau by two metres, and the Tabuchet by twelve and twenty-five metres on its two fronts

In reality, however, this retrogression was but temporary, caused mainly by the rarity of snow in the winter of 1920-21 and the relative dryness of For when the summer of 1922 came round the glaciers had all again clearly advanced, or had at least formed a front of clear blue ice as if the minimum were passed and advance were looming That this view was correct has since ahead again been clearly proved by the measurements made during the summers of 1923 and 1924 In 1923, for example, the Grandes Rousses glaciers showed unmistakable frontal advances since their last measurement; for example, the glaciers des Rousses and des Quirlies had each elongated by three metres, and the Saint Sorlin by fourteen metres In 1924 the glacier du Mont-de-Lans exhibited an advance of sixteen metres since 1921, the glacier du Lac ten metres, the glacier de la Meije seven metres, the glacier du Tabuchet thirteen metres, and the glacier de l'Homme five metres. The positions of 1919 have thus not only been recovered but also passed, and the fronts were all of clear, beautifully clean ice, while a considerable increase of superficial rapidity of movement was also observed, a sure sign of advance

Hence it seems certain that we are now really in a period of true advance of the glaciers of the Dauphmé Alps, a result in line with that derived from the Mont Blanc glaciological survey. The work on these Dauphine glaciers has been much more arduous, however, as the writer can testify from having actually seen some of the observers at work. On one occasion a number of them were lost for five hours in a terrific snow blizzard on one of the Meije glaciers, and only reached the refuge hut when frost-bitten and on the point of exhaustion. Such accurate work as is recorded in this report, carried out under such conditions, will be appreciated by all who read it, and most of all by those who know the ground, and the danger and tragic history of this group of mountains, the terrible Meije and its sister peaks, the last of the great Alpine peaks to be trodden by the foot of man A. E. H. TUTTON.

# The Development of Human Physiology. By Dr. C G. Douglas, C.M.G., F.R.S

In physiology our task is to study the nature of the phenomena which characterise normal life, as shown in the individual organism. At the outset it would perhaps seem presumption on our part to turn our attention to what we must admit to be the most complicated and highly-developed organism, namely, man, before we have been able to elucidate at least the main features of the life-process of more lowly forms; should we not do better to argue from the simple to the complex?

In the last fifty years we have seen the wide extension of what I may term the analytical method of physiological investigation, the attempt to differentiate the various components in the complex system which we call life, and to study in detail each of these components in turn and to render clear the The organism is in phenomena peculiar to each this method treated as a series of systems—we speak, for example, of the nervous system, the circulatory, the respiratory, and the excretory systems—which, though no doubt but parts of a whole, are yet capable of being treated within limits as independent In pursuing this method we have a perfectly definite aim, for we are trying to establish elementary facts about the different parts of the body without some knowledge of which we feel, and feel rightly, that a general conception of the whole is impossible. No one can deny that we have acquired in this way a mass of information which is essential to the whole study of physiology, nor is there any reason to suppose that the future will witness any diminution either in number or importance of the contributions thus made to knowledge.

 $^{1}$  From the presidential address delivered to Section I (Physiology) of the British Association at Leeds on Sept. 2

The bulk of this information has been attained by the deliberate and careful investigation of animals by experimental methods, and as I am going to plead the cause of human physiology, may I say at once, lest any one should misconceive my purpose, that I do not believe that progress in physiology and in medical science to the lasting benefit of mankind is possible without employing such methods. But, while acknowledging the great debt which we already owe to these investigations, and my firm conviction that their further prosecution will be fully justified in the future, I have to face the question whether the method has not in reality some limitations

We are bound, I think, to admit frankly that direct observation by methods involving operative procedure on the anæsthetised animal cannot by itself give us the full answer that we require. I have defined physiology as the study of the nature of the phenomena which characterise normal life, and normal life involves constantly varying activity of all the different organs of the body Under the influence of an anæsthetic our subject is no longer normal, and we have perforce deliberately to close our eyes to that fundamental aspect of life—ceaselessly varying natural activity. We are forced to adopt methods of investigation which are essentially highly artificial; the stimuli which we employ are usually coarse, and the changes to which we subject the organs gross, compared with the delicate alterations to which these same organs respond in natural life

If we are to understand life we must ultimately adopt methods of investigation which do not interfere with the normality of the organism or its power of self-maintenance; and clearly, so long as

we keep this aim before us, we are perfectly justified in making our observations on any animal the study of which we think will help to solve our problem. The conditions will be satisfied so long as our experimental treatment, whether that involves operative procedure or not, does not materially prejudice the delicate regulation of bodily functions which is so evident in the normal The point which I want to intact animal. emphasise is that, in the study of normal physiology, man is in many instances a far more advantageous subject for investigation than are the lower

It may be urged that, so far as concerns the natural variations in activity of everyday life, we may study the lower animals just as profitably as man. But can we guarantee that any animal, even though highly trained, will provide the particular state of activity that we may require at the moment? Man at least will conform with our requirements, and will maintain at request either rest or any degree or type of activity which we may desire. What is more, he, though himself the subject of investigation, can help us to make our observations, and very often intelligent co-operation on the part of the subject may render easy experimental procedure which would otherwise be impossible. We gain, too, the advantage of learning the subjective impressions of the person on whom we are making our experiments.

A review of the advances made in recent years in our knowledge of the general metabolism and energy exchange, of the regulation of the respiration and circulation, of the function of the kidneys, digestive organs, and nervous system, and of the general adaptation of the body to alteration of environment justifies the assertion of the advantage derived from studying the human subject; for experiments on man have already thrown much light on the actual quantitative changes in organ activity during normal life, on the close functional linkage of different organs and on the power of adaptation to altered circumstances. Direct experiments on anæsthetised animals, on the other hand, very often afford information about potentialities in the body rather than actualities.

The more we examine the normal behaviour of the body the more is it brought home to us that the maintenance of the natural life and integrity of the organism depends on the closest co-ordination of all its different parts; all the organs are interdependent, and can have no real existence save as active components of a corporate whole. Life consists of a delicate balance of all the different functions, a balance that is being continually adjusted so as to ensure the maintenance of the true functional capacity of the organism in its struggle for self-preservation in a constantly varying environment. As an agent in securing this exquisite co-ordination a physico-chemical change in the blood stream may at one moment be prominent, at another moment a nervous reflex. Very frequently both factors co-operate, the physicochemical change ensuring perhaps strict quantitative co-ordination of activity, the nervous reflex offering the advantage of speed and simultaneity of response in parts of the body remote from another. The two factors are not antagonistic, one is not gradually supplanting the other, but each plays its part in its own peculiar sphere

When we recognise the exactness of the coordination of the different functions in normal life, we cannot fail to appreciate the relative cludity of some of the experimental methods we are forced to use in physiology. Methods that interfere with the mutual interdependence of the different organs can only give us a partial insight into the problem of life, and if we use these methods, we must correct the impression that we gain by comparison with the true normal.

When we review the development of physiological thought in the last quarter of a century, we cannot close our eyes to the fact that investigations on man are becoming of increasing importance, and that the contribution made by human physiology does not involve mere matters of detail. There is something of far more importance than that, for the evidence of balanced interaction of the functions of the different organs with the preservation of the functional integrity of the whole, which is so convincingly brought home to us in experiments on the human subject, has made us appreciate that in physiology the organism as such, be it man or one of the lower animals, is our unit, and that, whatever methods we may employ in our investigations, we must keep that essential fact before us. In the problem of what is meant by life we have set ourselves the most complicated puzzle in existence. I firmly believe that human physiology, limited though our knowledge may as yet he, has already given us a vague glimpse of the final picture which we hope to complete, and has put us in a better position to fit together the individual fragments, the tiny components of the puzzle, which we have been accumulating in such profusion in years past.

The truth is that we cannot confine ourselves exclusively to any one method in physiological investigation. Unless we deliberately study the normal organism in its entirety, I do not see how we can gain any adequate conception about what is really implied by life, but once we have begun to gain that conception we can employ the methods of detailed analysis about which I have spoken earlier with hope of real success There has been a tendency of late to differentiate the subject of bio-chemistry from physiology, but this distinction, though it may have the merit of administrative convenience, can have no real justification if the ultimate aim of the physiologist and bio-chemist is, as I suppose, the same, namely, the investigation of the nature of living processes Physiology and bio-chemistry in fact merge into one another, and if we call to our aid the resources of chemistry and physics, that need not imply that we are any the less physiologists, but we have to be on our guard that we do not by imperceptible degrees turn from the path of biology into that of pure chemistry and, in so doing, miss the goal that we set out to attain. If an example is needed of the application of

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chemical and physical methods of investigation to the normal living organism, I would point to the work that has been done on human physiology, for it seems to me that a just claim may be made that in that there is represented at least one aspect of true chemical physiology.

In our enthusiasm for research we are apt to overlook the fact that unless our teaching can keep pace with our research the general advance of learning must be seriously impeded. I cannot help feeling that our teaching of physiology would be more satisfactory if human physiology occupied a more prominent position. I am not thinking so much in this connexion of advanced teaching, for the number of students who take advanced courses is relatively small and it is fairly easy to arrange suitable work for limited numbers. The great majority of students who take up the study of physiology do so as a preliminary to a medical career, and but few of them in the end pass on to advanced courses, and it is of the elementary teaching of physiology required as a preliminary to the study of clinical medicine, or an antecedent to more advanced honours courses, that I wish to speak.

So far as the theoretical side of physiology is concerned, books enough and to spare are available; and if the student is dissatisfied with his textbook or his teachers he can turn, unless he is appalled at the prospect, to the ever-increasing number of monographs, reviews, and special volumes which offer to him information on almost every conceivable branch, however obscure, of physiology. It is, I think, the practical instruction in physiology with which we may legitimately find fault. We are, I suppose, in part tied by tradition, in part handicapped in our laboratories by the accumulation of apparatus of bygone days, and it is easy to point to lack of funds as an excuse for continuing in the same path as those who preceded us. The fact remains that so far as elementary practical physiology, as distinct from bio-chemistry, is concerned, reliance is still largely placed upon an experimental treatment of some of the rudimentary phenomena exhibited by amphibian muscle and nerve I do not deny that some of these experiments do afford information which is of value to the student, but I am also prepared to maintain that others are merely artificial, and but relics of the past that would be better omitted, and that they in no way represent the viewpoint of the present day in this branch of physiology. But though experiments on muscle and nerve still figure largely in the physiological curriculum, it is noticeable that simple experiments illustrating the progress of more recent years are gradually being introduced, and that in some laboratories a far more serious attempt has been made to remodel the curriculum than in others, and to afford an opportunity for gaining acquaintance with some of the facts of human physiology

Such a change in outlook is very welcome. When dealing with a subject which is so rapidly progressive as physiology, I feel that we are bound to reconsider our methods of teaching at intervals,

if we are to render those whom we instruct reasonably conversant with the actual state of knowledge at the time, mere addition to the curriculum is of no use, what is needed is reconstruction. Do not think that I say this in any carping spirit. After all, some facts have become so firmly established in the past as to have become axiomatic, and we must be content to accept many of these without constant repetition of their proof if time is to be found to give the student some indication of the experimental developments which have led to alteration and extension of our earlier conceptions. If practical courses of instruction are to play their full part and not degenerate into simple exercises in skilful manipulation, they must be brought into line with current physiological thought, they must, even though the experiments be simple, help to convince the student of the meaning and truth of what he reads I am certain myself that a serious attempt to incorporate even in elementary courses experiments on human physiology will be amply justified

I confess frankly that in my own case if I want to understand the facts of physiology I have to think of what they might mean to me in my own person; I cannot think easily in terms of lower animals I have got to translate the information before I can use it. I do not believe that I am peculiar in this respect Many a student would, I am sure, acquire a deeper and more real interest in physiology if his attention was directed to some of the essential facts of human physiology at an early stage in his instruction Show him something of what really happens in himself in the natural course of his daily life, awaken his curiosity about the way in which these events are actually accomplished, and he will then more readily understand the significance of what he learns from other sources. As it is, he runs the risk of being overwhelmed by the literature of the subject that he is studying and of losing himself in details which he cannot place in the right perspective: he too often fails to see the wood for the trees. The quantitative interdependence of function in the body can be well illustrated by simple experiments in human physiology; and a more convincing introduction to those quantitative conceptions which must form the basis of physiology, as of other branches of natural science, can be gained, I think, in this way than by, say, a few quantitative bio-chemical analyses which, essential though they may be in themselves, can scarcely be more than exercises in method in the early days of a student's career

These students are for the most part going to follow the profession of medicine, and in the short time available our aim must be to develop their powers of thought and initiative that they may be the better equipped to face the future when they go out into the world, and if they leave us with only the recollection of a medley of seemingly disconnected facts, it is quite intelligible that they may fail to grasp what physiology really means, and that a gulf, for which there can be no justification, will deepen between physiology and medicine. Physiology is not medicine: the physician sees a

side of life which the physiologist does not meet in the cold alootness of the laboratory. The art of medicine is not based merely on the application of skilled technique, it demands in addition a full and sympathetic comprehension of human nature with all its hopes and fears, its frailty and courage. Yet the more the physiologist can find out about the characteristics of normal life the greater will be his service to medicine, for a knowledge of the normal cannot but help us to estimate with greater certainty the influence of the abnormal, and the underlying principles of adaptation of organ activity which we as physiologists recognise in the functional changes which exhibit themselves in everyday life, and, in the reactions to alterations of environment, have their counterpart in medicine in the natural efforts at compensation for the effects of injury or disease, a compensation which it must be the aim of the physician to encourage and assist.

There is yet another field in which scope may be

found for human physiology. In the growing complexity of the modern world the improvement of the general standard of life is a matter which appeals to all of us. Physiologists have already played a prominent part in investigations into the means by which conditions may be improved and risk reduced in industrial processes, into the factors which affect the efficiency and welfare of the working classes, and into the influence of diet on health Problems such as these, the solution of which is of direct benefit to the community at large, call for the practical application of physiological principles We ought not to regard applied physiology as something distinct, as something to be divorced from the more academic study of theoretical physiology, it should be looked upon as the natural extension of our researches in the laboratory. These practical problems in their turn often suggest new lines of inquiry, new methods of approach, by which the science of physiology may be still further advanced.

#### Obituary.

Prof. R. A Lehfeldt.

PROF. ROBERT ALFRED LEHFELDT, professor of economics at the University of the Witwatersrand, Johannesburg, whose untimely death is reported from Cape Town, was born at Birmingham on May 7, 1868, and thus was in his sixtieth year. Lehfeldt's initial education and pursuit of science was largely the outcome of strenuous personal endeavour. Obtaining a scholarship at St. John's College, Cambridge (1886), he secured a first class in both parts of the Natural Science Tripos. Meanwhile he read for a London degree, eventually taking his D Sc. in physics. On leaving Cambridge, Lehfeldt occupied a post as demonstrator in physics at the University of Sheffield (then Firth College); later, he became professor of physics at the East London Technical College, remaining there until appointed (1906) to the chair of physics, Transvaal Technical Institute, Johannesburg, a post resigned on his acceptance (1917) of the professorship of economics in the University of the Witwatersrand.

Among several papers by Lehfeldt published in the *Philosophical Magazine* are . "A Potentiometer for Thermocouple Measurements" (1903), and "The Treatment of Electrodynamics" (1909). He translated from the German, Van't Hoff's lectures on theoretical and physical chemistry (3 vols., 1898–1900), also Nernst's theoretical chemistry (Macmillan, 1904), revised m accordance with the fourth German edition. He was the author of a text-book of physical chemistry (general theory) in the series edited by Sir William Ramsay (1904, a new impression appearing in 1920). Lehfeldt was a valued worker for the Royal Society's "Catalogue of Scientific Papers," series 1884–1900. His services are referred to, along with other coadjutors, in Vol. 13 (1914).

In certain fields of economics Lehfeldt was a persistent advocate. The *Economist* published on Nov. 6, 1926, the first of a series of five articles of his (afterwards appearing in pamphlet form) entitled

"Controlling the Output of Gold." A proposition embraced the setting up of an international commission charged with the duty of buying out and becoming the owner of the gold-bearing and gold-producing ores of the world. Lastly, the *Economist* on Sept 24, 1927, published suggestions leading to a more economic mode of currency in England.

In early years Lehfeldt was reticent, difficult of approach, and somewhat inclined to moodiness. Unfortunately, it would seem that these general characteristics, so far from diminishing with time, gathered force. Notwithstanding, he accomplished much sound work in science and in cognate subjects, and his old associates at home and those overseas will deeply deplore his premature decease

PROF. LUDWIG DARMSTÄDTER, director of the State Library, Berlin, died on Oct 18. A native of Mannheim, Darmstädter was educated at the Universities of Heidelberg, Leipzig, Berlin, and Paris. About twenty years ago he presented to the State Library, Berlin, his valuable collection of porcelain and of autographs and other documents relating to men of science. This collection, known as the "Dokumenten-Sammlung Darmstadter," has developed until it is probably the largest of its kind. His best-known work is the "Handbuch zur Geschichte der Technik und Naturwissenschaften."

WE regret to announce the following deaths:

Dr. M. Bamberger, emeritus professor of inorganic chemistry at the Technische Hochschule in Vienna, on Oct. 22, aged sixty-six years.

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Dr. R. A. Herman, lecturer in mathematics in the University of Cambridge, on Nov. 29, aged sixty-six years.

Lord Kenyon, K C.V.O., president of the National Museum of Wales, on Nov. 30, aged sixty-three years. Prof. Perley F. Walker, dean of the school of engineering of the University of Kansas since 1913, who was known for his work on steam and gas power engineering, on Oct. 17, aged fifty-two years.

#### News and Views.

AT first sight a student referring to a text-book would think that the evolution of the Proboscidea is a comparatively easy matter to understand. The picture of a straight line of descent from the little Moeritherium, through Palæomastodon, Mastodon, Stegodon, and so on up to the later mammoths and elephants, seems very easy to read Closer examination, however, and a reference to the enormous literature on the subject, reveal a most complicated state of affairs. There is an immense number of families, genera, species, and sub-species of elephants already described, many of them still inadequately known, there is still no very clear agreement of what constitutes a specific character in an elephant, and there are many widely diverging views as to the real relationship of the various forms one to another. As species of elephants, e.g. E. antiquus, E. trogontherii, E. primigenius, E. meridionalis, are so often used as time markers, it is essential that we should have a clear idea as to what they are and as to their interrelationships. Yet we find specimens described as intermediate by some authorities and the statement hotly denied by others.

THE fact is that the taxonomy of the elephant group is in the greatest confusion Prof. Osborn's forthcoming memoir may confidently be expected to clear up the situation in some degree, in that it will present the facts so far as they are known at the present time. It cannot be expected to be a final pronouncement, because the evidence is not yet complete. Facts are still needed, and every new one that comes to light is important. The Upnor elephant, for example, now mounted in the British Museum, has yielded some new facts, and rather surprising ones, to what we know about E. antiquus. In producing some new facts, Prof. Dart's description in the Supplement to this issue of Nature of new proboscidian material from South Africa is therefore greatly welcome. If this most interesting discovery adds for the moment to our perplexity, it is nevertheless additional evidence which, in time and with the discovery of further material, will in the future yield its quota to the solution of the filiation, distribution, migration, and general knowledge of the group.

AT the anniversary dinner of the Royal Society, held on Nov. 30, Mr. Baldwin, the Prime Minister, as principal guest, proposed the toast of the Society, of which he was recently elected a fellow. It should be said that the inclusion of certain persons not actually engaged in scientific pursuits is a practice sanctioned by long usage In the Society's original statutes of 1663, whether wisely or not-and there were mundane considerations—it was provided that every one of His Majesty's subjects having the title and place of baron, or any other higher title and place, and every one of His Majesty's Privy Council, might be elected. With slight variations these intentions were preserved down the years, until. in course of time, such persons formed a panel or privileged class. As regards foreign members, the procedure was different altogether. In 1765 it was resolved that no foreigner be proposed for election "that is not known to the learned world, by some publication or invention". Discussion in 1873 on a motion to require in the privileged class, "evidence of ascertained special power and disposition to forward the aims of the Society from exceptionally personal, or official advantages of position," ended by limiting the privileged class to princes of the blood royal and members of the Privy Council

STATUTES enacted by the Royal Society in 1902, and still followed, abolished the clause relating to privy councillors, simply providing that once in every two years the Council may recommend not more than two persons who "either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the Society." It is permissible to say that the implications of this statute seem clear enough opportunities of the chief officer of State in the scientific arena are recurrent and understood: as political moves they would be an affront to science. No one doubts that Mr Baldwin will honour the bill. and that inclination and temperament will be allied in furtherance of aims which bring science into touch with schemes that affect the national well-being We are mindful that Mr. Joseph Chamberlam, as a Government official, passed the word that research and preventive measures in tropical diseases were necessary and must be undertaken. What followed made history

A CORRESPONDENT recalls the interesting fact, in connexion with Mr. Baldwin's election, that in recent times three precedents can be recorded for the election of a Prune Minister into the Society whilst holding the seals of office The instances are: Mr. Disraeli, elected on Feb. 10, 1876; Mr. Gladstone, elected on Jan 13, 1881, the Earl of Oxford and Asquith (then Mr Asquith), elected Nov. 5, 1908 The first-named was formally admitted by Dr. J D. Hooker on June 1, 1876, that being the day fixed for the election of ordinary fellows. Amongst these (and surviving) were Prof H E. Armstrong and Sir David Ferrier. Mr Gladstone was admitted on May 19, 1881, on which occasion William Crookes read a paper, "On Discontinuous Phosphorescent Spectra in High Vacua." Sir William Thiselton-Dyer, who had been elected a fellow in the previous year (1880), survives, and, indeed, may have witnessed Mr. Gladstone sign the charter book.

Considerable interest has been aroused by the report in the press that concessions were believed to have been granted to a British syndicate for the purpose of utilising the vast mineral resources of the Dead Sea. This interest was reflected in the very pertinent questions put in Parliament a few days ago. From the reply given in the House of Commons by Mr. Ormsby-Gore, it appears that although it has been decided in principle to grant a concession to

certain individuals, the terms and conditions are still under negotiation. The potassium salts of commerce are derived largely from the Stassfurt deposits in Germany. At the outbreak of the War in 1914, these supplies were closed to the Allies and a serious dearth ensued. The waters of the Dead Sea are heavily charged with mineral salts. They are estimated to hold in solution some 2000 million tons of potassium chloride, a quantity that may be regarded as practically inexhaustible from a commercial point of view. In the event of war, these supplies, if accessible, might be extremely valuable to the British Empire, and considerable anxiety has been manifested lest Germany or some other foreign power should acquire controlling interests over these supplies.

LORD LOVAT stated in the House of Lords that the Government is fully aware not only of the economic importance of the Dead Sea deposits, but also of the political questions that may arise in the event of these deposits being worked. This, in so far as it goes, is reassuring. It must be borne in mind that the whole scheme is at present merely in an experimental stage. Whilst, as a purely chemical proposition, it may not be difficult to prepare the different salts in a sufficient state of purity to meet modern requirements, the placing of these salts upon the European market at competitive prices may be no easy task. The level of the Dead Sea is some 1300 feet below that of the Mediterranean, and Jaffa. the nearest port, is hemmed in by rocks to seaward which effectively bar the approach of any but the smallest boats. Thus the problem of transport alone, in a country which is devoid of fuel, in the face of the ready accessibility of the Stassfurt deposits, is one of considerable magnitude.

THE Institute of Chemistry of Great Britain and Ireland, which was founded in 1877 and incorporated by Royal Charter in 1885, celebrates its jubilee on Dec. 14 and 15. In the proceedings the fellows and associates of the Institute will be joined by members of nine allied chemical societies and institutions and their ladies. On Wednesday, Dec. 14, there will be a conversazione and reception by the president, Prof. Arthur Smithells, and Council of the Institute, and on the following evening a dinner, at which the president will occupy the chair, both events taking place at the Wharncliffe Rooms, Hotel Great Central, Marylebone. For this year the jubilee dinner will take the place of the annual Chemical Dinner. An exhibition of films illustrating British industries in which chemistry is applied has been arranged for Thursday morning, Dec. 15, and on both days the Council Room, Library, and Laboratory at 30 Russell Square, W.C.1, will be open to members of the participating organisations. Documents, portraits, apparatus, and prints of historical interest will be on view, and the Institute's collection of lantern slides illustrating the history of chemistry will be displayed. On Dec. 15, the Master and Wardens of the Worshipful Company of Salters will entertain the officers of Institute and representatives of other societies at |

luncheon. The Institute of Chemistry, which is well known as a body which grants certificates of competency in various branches of the profession with the object of maintaining a high standard of scientific and practical professional, and deals also with questions of status and professional conduct, now has a membership roll of more than 5300 fellows and associates practising in all parts of the Empire, and 800 student-members. There are sixteen local sections, and a number of honorary corresponding secretaries who act for the Institute in the Dominions and Colonies, and in the Empire of India.

IMPERIAL CHEMICAL INDUSTRIES, LTD, has taken yet another important step in the direction of promoting closer relations between so-called 'pure' and 'applied' chemical research. By its establishment of a research council, which will function as an advisory board and clearing house for ideas, a close hason will be effected between industry and the universities. The connexion thus strengthened between those engaged in academic and industrial pursuits provides a stimulus for the flow of vitalising force in both directions; not only will the scheme lead to efficiency of action and economy of effort in the attack on industrial problems, but it should also lay the foundations of a greater appreciation of the industrial situation by academic research workers. This is the first body of its kind to be established in Great Britain, although the value of similar organisations has been amply demonstrated in other countries. The scheme will doubtless play a significant part in helping to place British practice on more than competitive terms with modern achievements and organisations elsewhere. The council will be presided over by Sir Alfred Mond, and the other members will be Dr. G. C Clayton, M.P., Col. G. P. Pollitt, Mr. J. Rogers, Dr. F. A. Freeth, Dr. E. F. Armstrong, Dr. R. E. Slade, Mr. H. A. Humphrey, Sir Frederick Keeble, Prof. F. G. Donnan, Prof. R. Robinson, Prof. W. A. Bone, Prof. F. A. Lindemann, and Dr. E. K. Rideal, with Major A. E. Hodgkin as secretary.

On Nov 23, Sir Alfred Mond gave his presidential address to the Institute of Fuel, which has resulted from the union of the Institute of Fuel Technology and the Institution of Fuel Economy Engineers. He announced that Mr. Frank Hodges would be the new president, and gave an account of the plans and policy of the new body. The address, which was of a general character, dealt with economic rather than scientific problems. There was, however, a hint of a method, now under probation, for reducing the ash of coal to 2 per cent—an achievement so desirable that it seems too good to be true. A new application of pulverised fuel was mentioned—the use of coal dust in place of oil in the Diesel engine The realisation of such an engine might open a new vista to the coal trade. Sir Alfred advocated more study and care to prevent size reduction of coal in transport and handling, for this usually involves a diminution in market value. On the economic side he pleaded for amalgamation of units, for reorganisation of the coal industry, for reduction of the personnel by pensioning the older men, the relief of rates, taxes, and transport costs, the assistance of the State in raising the capital necessary for modernisation, as, for example, in the case of coke oven installations.

Readers of Nature will note with special interest Sir Alfred Mond's views on industrial research—his advocacy of its intensification by the use of whole teams where now individuals work. This he regards as necessary not merely to ensure progress but even to maintain our position. The coal industry seems to offer a wide field for the scientific advancement which is necessitated by international competition applies both to production and selling Thus he holds that the sale of coal of a guaranteed uniform standard would assist the export trade more than the cutting of piices, which has been the normal economic weapon of our collieries The programme of this meeting of the Institute of Fuel was interesting, and the papers of importance to actual problems. The aims of the new body are wholly beneficent, but appear to be covered by already existing organisations. Opinions differ as to whether it can accelerate technical progress. So far as the scientific worker is concerned, the multiplication of institutions, with attendant drain on purse, time, and energy, may hinder as much as help.

A PAPER on national electricity supply was read to the Institute of Fuel on Nov 23 by Sir Philip Dawson He pointed out that whilst in Great Britain only 40 per cent of the total motive-power required for industry is electric, in Germany the percentage is 70, in the United States 65, and in Belgium 56. In Great Britain large reserves of coal remain unworked because of their high ash content. They could easily be worked with the rest of the seam and sold at a cost of from four to five shillings per ton at the pit's mouth. This fuel has a calorific value about double that of the brown coal so successfully utilised in Germany, but so far little or no attempt has been made to utilise it in Great Britain. In the future these poor qualities of coal, which it does not pay to transport, should be used in the form of pulverised fuel to produce electricity at the colliery. In England, only 14 per cent. of the coal mined is cut mechanically. This compares with 47 per cent in Scotland excess gas produced in steel works should be utilised for generating electricity, as this could be profitably supplied to the network controlled by the Central Electricity Board.

SIR PHILIP DAWSON stated that we are only beginning to reap the benefits of co-operation and co-ordination in the generation and transmission of electricity. Wherever interconnexion has been carried out, it has resulted in greater safety and more perfect continuity of supply. In Sir Philip's opinion, the result of the 1926 Act should bring about, in the best sense of the word, a national and not a nationalised supply of electricity in Great Britain. In the discussion, Sir Arthur Duckham said that for the supply network in the Clydeside area, the first scheme put forward by the Central Electricity Board, not a single colliery has offered to supply electricity to the system.

It is possible that in the future the collieries will utilise for their own purposes electric power from the network, some of which is generated by water, instead of economically generating it themselves by their own low grade fuel

ONE or two years ago, Dr Karolus, of Dresden, claimed to have achieved television by means of apparatus which transmitted 100,000 units of the image in one-tenth of a second We now learn from the Times of Nov. 30 that his system of transmitting photographs and papers which may be coloured—except green, blue, and mauve, which are not recommended by telegraph wires has been adopted by the Austrian telegraph department The pictures sent may portray persons or drawings, cheques, structural plans, documents, or writings by hand or type. The size of the picture or type must not exceed 4 inches by  $7\frac{1}{2}$  inches, the minimum being 4 inches by  $1\frac{1}{2}$  inches The paper must be opaque and the writing clear and easily read. It is stated that the largest strip will accommodate 400 words in pearl type. The charge for the transmission of the smallest permissible picture from Vienna to Berlin is 7s. 11d, each additional 12 square inches costing 2s. A reduction of about 25 per cent is made if the picture is transmitted during the night hours, that is, between 9 P.M and 8 A.M. The Siemens' Electrical Company, which is producing the apparatus, has modified Karolus's original system Full details will be awaited with interest, as the transmission of coloured prints and photographs by telegraphy has hitherto not reached the commercial stage.

Most hearty congratulations are due to the veteran Prof. W. Cawthorne Unwin, F R.S., who, on Monday next, enters on his ninetieth year. Born at Coggleshall, Essex, he was educated at the City of London School, and on leaving became a pupil in the firm of William Fairbairn, Manchester. Next he undertook the managership of some engineering works, thereafter filling a post as an instructor in the Royal School of Naval Architecture and Marine Engineering, South Kensington He was professor of hydraulic engineering at the Royal Indian Engineering College, Coopers Hill, from 1872 until 1885; afterwards, for twenty years (and these were fruitful in effort) he taught the principles of engineering at the Central Technical College, City and Guilds of London Institute. Prof. Unwin is a past president of the Institutions of Civil and Mechanical Engineers. At the latter there hangs a portiait of him by Mr. Harold Speed.

Dr. R T. A. Innes, who is retiring at the end of this year from the post of Director of the Union Observatory, Johannesburg, was born in Edinburgh, and when a young man went to Australia. To the Monthly Notices of the Royal Astronomical Society of 1892 he contributed a paper on the secular perturbations of the earth by Mars. In 1896 he joined the staff of the Cape Observatory as secretary, librarian, and accountant. Although forming no part of his official duties, he executed three valuable pieces of astronomical work: (1) A revision of the Cape Photographic Durchmusterung; (2) a general catalogue of

southern double stars, of which he discovered 280 with a 7-inch equatorial; (3) observations of variable stars. In 1903 he was, on Gill's recommendation, appointed Director of the Meteorological Observatory of the Transvaal. Gradually astronomical equipment was obtained for the Observatory, and many of the photographs of Mr Franklin-Adams' survey were taken at the Johannesburg Observatory by Mr. Wood, Dr. Innes' assistant. Dr Innes set his heart on a large visual refractor for double-star work Owing to the difficulty of obtaining optical glass and to the War, he suffered the disappointment of long delay; and it was only two years ago that a 26-inch refractor was received. He continues his interest in the motion of sun, moon, and planets, and the cause of the small but persistent differences from tables based on gravitational theory Following the example of Gill, he has welcomed at Johannesburg astronomers from the northern hemisphere, where he is able to supply sky and equipment and thus makes up for a small staff

The seventieth birthday of Prof. S. G. Navaschme, the distinguished botanist, will be celebrated in Moscow on Dec. 21 at a special meeting to be held in the University, where congratulatory addresses and greetings will be presented to him. Prof. Navaschme is a foreign or corresponding member of a number of national and botanical societies, and his botanical work is highly esteemed over a wide circle. Letters or telegrams of congratulation should be addressed to Prof. M. J. Golenkin, director of the Botanic Garden, University of Moscow, U.S.S.R.

On Nov. 30, the portrait of Prof. J. A Floming, painted by Sir William Orpen, was presented to University College, London, by the chairman of the Portrait Fund Committee, Mr. Campbell Swinton. The gift was received on behalf of the College by Lord Chelmsford, chairman of the College Committee, and Prof Coker, Dean of the Faculty of Engineering. In making the presentation the chairman gave an engaging account of the eminent artist's method of producing so strikingly successful a result. Lord Chelmsford, in acknowledging the gift, said that Prof. Fleming's life and work have shed lustre on the College, and that more than 2000 students have passed through his hands, three of whom have been presidents of the Institution of Electrical Engineers. Prof. Coker also testified to the distinguished career of Prof. Fleming, both as teacher and investigator. The chairman then presented Prof. Fleming with a copy of the portrait. In accepting it, Prof. Fleming briefly outlined the growth of his Department of the College, and stated that he intended presenting the copy to the Institution of Electrical Engineers. This he did on the following evening. The copy of the portrait was received by the president of the Institution, Mr. Page, who thanked Prof. Fleming for his gift in very cordial and appreciative terms.

At the annual general meeting of the fellows of the National Institute of Agricultural Botany at Cambridge on Dec. 2, Sir Daniel Hall, who presided as chairman of the Council, submitted the annual report and presented to Sir Matthew Wallace the John Snell

Memorial Medal for 1926 Papers were then read dealing with different aspects of the testing and control of agricultural seeds. Mr A W Monro, of the Ministry of Agriculture, dealing with the administrative aspect, recalled that the regular testing of seeds for purity and germination began in Germany m 1870 and Denmark in 1871. Ireland established an official seed-testing station in 1900, Scotland in 1914. and England and Wales in 1917. Legislative control m the United Kingdom began with the Irish Weeds and Agricultural Seeds Act of 1909, and was extended to the whole country by the Testing of Seeds Order in 1917. This was superseded by the Seeds Act, 1920. The basic principle of the Order and the Act is to let the farmer know what he is buying by compelling the seller to disclose the essential facts -origin, variety, purity, and germination - -in the case of the principal agricultural seeds Seed morchants, taken as a whole, comply readily with the regulations, but farmers who sell seeds to their neighbours are apt to ignore them. The information required by the Act is obtained by tests at the official stations - Cambridge, Edinburgh, and Belfast- or at one of the 88 private stations licensed by the Ministry. In the opinion of Mr Monro. the principal effects of the Act have been to raise the quality of the bulk of the seed supplies, so far as purity and germination are concerned, to the high standard that has long been observed by the best merchants, and to drive off the market the lower grades of grass, clover, and root seeds.

MR. ALFRED EASTHAM, the Chief Officer of the Official Seed-Testing Station for England and Wales, read a paper on the technical aspects of seed testing Essential though accuracy is in seed testing, it is now generally recognised that the efficiency of the routine work depends upon constant investigation of the underlying principles and their adaptation to the changing character of the seasons. In addition to these routine investigations, there are many special problems under examination at the Cambridge Station. Examples of these problems are (a) the loss of vitality in seeds and the bearing which storage conditions have upon the rate of loss, and (b) seedborne diseases Both are of much importance to all who are interested in seeds, and during the past four years a great deal of time has been spent upon them. A seed-testing station's first duty is to report on the purity and germination of the samples it tests; but, though high percentages of purity and germination are most desirable, too much value should not be placed upon them The nationality of the seed, its vigour, and the nature of the impurities present must be kept in view Strain is of the first importance, and, provided it is free from harmful impurities, seed of a good strain but of comparatively low purity and germination is much to be preferred to seed of a poor strain, however high its purity and germination; for the latter might easily fail to produce a satisfactory

THE Library of the Chemical Society will be closed for the Christmas holidays at 1 p.m. on Friday, Dec. 23, and will reopen at 10 a.m. on Thursday, Dec. 29.

Mr. S. Zuckerman, of the University of Cape Town, has been appointed to the research followship in anatomy, and Miss Eleanor Margaret Brown, of University College, London, to the aquaitum research fellowship, offered by the Zoological Society of London.

For the meeting of the British Association to be held next year in Glasgow on Sept. 5-12, under the presidency of Sir William Bragg, the following sectional presidents have been appointed Section A (Mathematical and Physical Sciences), Prof A W. Porter; Section B (Chemistry), Prof E C. C Baly, Section C (Geology), Mr. E B. Bailey, Section D (Zoology), Prof. W Garstang; Section E (Geography), Prof. J. L. Myres, Section (# (Engineering), Sir William Ellis; Section H (Anthropology), Sir George Macdonald, Section I (Physiology), Prof. C Lovatt Evans; Section J (Psychology), Prof. T. H Pear, Section K (Botany), Prof. R H. Yapp, Section L (Education), Prof. A Smithells, Section M (Agneulture), Dr J. S Gordon. The president of Section F (Economic Science and Statistics) will be announced later

AT an extraordinary meeting of the General Committee of the British Association, held on Dec. 2, the president, Sir Arthur Keith, in the chair, it was resolved to put forward an application for a Royal Charter for the Association. Mr. A. A. Campbell Swinton was warnly thanked for his generous offer to bear the cost of obtaining the charter. It was also resolved "that the General Committee gratefully accepts Mr Buckston Browne's generous offer to vest Downe House in the Association, and authorises the president to make any suitable arrangements for the custody of the property in the interval between the acquisition thereof and the granting of a Charter."

A LIFE-SIZE bronze statue of the late Dr. John A. Brashear, well known as the maker of numerous large telescopes and astronomical instruments, and the founder of the new Allegheny Observatory, has been placed in the rotunda of the Observatory and was unveiled on Nov. 24, the anniversary of his eighty-seventh birthday. The statue is the work of Mr. Frank Vittor, and is a gift to the University of Pittsburgh from a number of Dr Brashear's life-long friends.

The following officers and new members of council of the Cambridge Philosophical Society have been elected for the session 1927–28: President, Dr H. Lamb; Vice-Presidents, Prof. J. T. Wilson, Prof. A. Hutchinson, Prof. G. I. Taylor; Treasurer, Mr. F. A. Potts; Secretaries, Mr. F. P. White, Mr. R. H. Fowler, Mr. F. T. Brooks; New Members of Council, Mr. W. H. Mills, Mr. M. H. A. Newman, Dr. H. Hamshaw Thomas, Dr. J. Needham; New Member of Philosophical Library Committee, Mr. R. H. Fowler.

An International Exhibition and Conference on Light and Heat in Medicine and Surgery will be held at the Central Hall, Westminster, on Dec. 13-16. The work of the conference will be divided into three sections, dealing with light and heat in medicine and surgery, scientific research in relation to the practice of actmotherapy, and recent advances in optics, respectively. The exhibition will be opened at 2.30 PM, on Dec. 13 by Sir Alfred Mond. The exhibition and conference are being organised by the British Journal of Actmotherapy, 17 Featherstone Buildings, London, W.C.1, from which tickets of myitation and vouchers for reduced railway fares can be obtained.

Reference was made in our issue of April 30, p 649, to the nineteenth meeting of the Australasian Association for the Advancement of Science, to be held at Hobart during the week commencing Jan. 16. A further programme recently received enables us to give more particulars of the meeting. The presidential address by Mr. R. H Cambage will be on the development of some early Australian floras. Sectional presidential addresses are topical, and refer mainly to Australian conditions. In addition to papers in the various sections, discussions have been arranged on research in relation to manufacturing industries in Australasia (physics, chemistry, and engineering sections), animal nutrition and pasture deficiency (chemistry, agriculture, and veterinary science sections), structure of colloids (chemistry and physiology sections), the marketing of fruit (economics section), the pharmaceutical chemist in the community and micro-chemical methods in testing pharmaceutical products (pharmaceutical section).

A Rubber Exhibition was opened at the Imperial Institute, South Kensington, on Dec. 2, by Mr. Hacking, Parliamentary Secretary of the Department of Overseas Trade, and will remain open until Dec. 31. This exhibition, admission to which is free, is the first of a series of short exhibitions of Empire products which will be held from time to time at the Imperial Institute. It has been arranged in conjunction with the Rubber Growers' Association and is divided into two parts, the first dealing with the production of raw rubber, and the second, with manufacture and application. A series of specimens of wild rubber plants, which were the only source of rubber until the modern plantation system was evolved, are shown; at the present time, this source is responsible for only about 5 per cent. of the total world production. Two allied rubber products are also exhibited, i.e. balata and gutta-percha. Both of these are chemically similar to rubber, although they differ in their physical properties. Further exhibits illustrate various processes of manufacture of raw rubber. The Research Association of British Tyre and Rubber Manufacturers has contributed an exhibit showing the compounding ingredients employed in the manufacture of rubber articles, and the Ceylon Rubber Research Scheme (which has its laboratories at the Imperial Institute) illustrates various investigations in connexion with the perishing of rubber and variations in its plasticity. About fifty firms have contributed to the exhibition A film showing the production of raw rubber and its utilisation in manutacture is being displayed in the adjoining cinema. Lecture tours are also arranged for those who care to avail themselves of these facilities.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A jumor sccretary (male) in the External Registrar's department of the University of London-The Secretary, University of London, South Kensington, S W 7 (Dec. 16) A graduate assistant in mechanical engineering at the Wakefield Technical College-The Director of Education, Education Offices, Town Hall, Wakefield (Dec 17). A Paterson research scholar in the cardiographic department of London Hospital—The House Governor, London Hospital, E 1 (Dec. 19) An additional research fellow in the department of glass technology of the University of Sheffield—The Registrar, The University, Sheffield (Dec 23). A junior assistant at the National Physical Laboratory with a good honours degree or equivalent qualifications in engineering—The Director, National Physical Laboratory, Teddington (Dec. 24) A principal of the Constantine Technical College, Middlesbrough—The Director of Education, Education Offices, Middlesbrough (Dec.

A lecturer in inorganic and physical chemistry at the Sir John Cass Technical Institute-The Principal, Sir John Cass Technical Institute, Jewry Street, EC.3 (Dec. 31) An assistant lecturer in geography in the University of Manchester-The Registrar, The University, Manchester (Jan 11). An assistant in the department of art of the National Museum of Wales—The Director, National Museum of Wales, Cardiff (Jan. 14). An entomologist and a plant breeder in the Agricultural Department, Iraq, the entomologist must have had specialised training in entomology and experience of research work and of pest control measures; the plant breeder must have had specialised training in genetics and, preferably, experience of plant breeding work—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W I. An adviser in mycology for the Bristol Province under the Advisory Scheme of the Ministry of Agriculture and Fisheries-The Registrar, The University, Bristol.

#### Our Astronomical Column.

NEW COMET — The tenth cometary discovery of 1927 is reported from Melbourne in a telegram distributed by the IAU. Bureau, Copenhagen. It was made by Mr J F Skjellerup on Dec 3 at 17 h 30 m., U.T., in R A 16h 12m 12s, S Deel 53° 57′ The comet was of the third magnitude, and had a

tail 3° long, it was moving towards the sun.

It appears very probable that this is De Vico's long-period comet 1846 IV., which has been searched for by southern observers since 1920. It so, its period is 811 years, and its perihelion passage about Dec. 15 No one has computed the perturbations of this comet since 1846, and it is possible to represent the position within a few degrees by the unperturbed elements, moreover, if identical, it would be only one-third of a unit from the earth, so any departure from its predicted place would appear exaggerated. It the identity is right, it will cross the equator about the time of perihelion, and will then pass in to high north declination The period is several years longer than the predicted one, but that causes no surprise. The comet Brorsen-Metcalf, 1847 V, returned in 1919, nine years before it was expected. Mr Skjellerup made several cometary discoveries when he lived in South Africa, but this is the first he has made since he moved to Melbourne

DETECTION OF A NEW NAKED-EYE CEPHEID.— Harrard Observ. Circular 316 contains the interesting announcement that the fourth magnitude star Beta Doradus has just been discovered to be a Cepheid variable, with a photographic light-range of 14 magnitude, and a visual one of nearly a magnitude. Miss Applegate was the first to suspect the Cepheid character, which she did by noting periodic changes in the type of spectrum; R. E. Wilson on the same grounds classed the star as a pseudo-Cepheid, not knowing of the light variation. This was not easy to detect photographically, the star's image being too large on most plates for accurate measures; but by a lucky chance, several images were found on plates with ten minutes' exposure taken in 1925 and 1926 for the light-curve of Nova Pictoris. The adopted period is 9.841696 days, and on plotting the observations with this period the variation is quite evident. The light-curve is symmetrical on each side of maximum and minimum, without any sign of a second harmonic. Prof. Bailey's visual photo-

metric observations made in 1899 at Arequipa were examined; it was found that his observations of this star showed an unusually large range, and in consequence he took a number of extra observations of it. These are now found to conform well with the adopted curve, but Bailey did not discover that the variation was regular.

Beta Doradus is one of the stars in the Nautical Almanac list, its magnitude being 3.81, spectral type Eichelberger F5p, proper motion according to -0.0031 sec in R.A.,  $+0''\cdot005$  in decl. The absolute magnitude from the period-luminosity curve is  $-1.9,\,$  giving a parallax of 0″ 0043, and a distance of 760 light-years.

SOLAR ACTIVITY DURING 1926 —The final values for the mean daily area of sunspots and Wolf's sunspot number for the year 1926 have recently been published by the observatories of Greenwich and Zurich respectively (Monthly Notices R. A.S., Nov. 1927, and Astronomische Mitteilungen, Nr. 116). The mean daily area of spots, corrected for toreshortening and expressed in millionths of the sun's hemisphere, is stated to be 1262 and the Wolf's sunspot number 63 9. Mean daily areas for periods of a solar rotation (Greenwich) and spot numbers for each month (Zurich) are also given in the respective publications.

The following table shows the progress of the present sunspot cycle since the last minimum in 1923:

Year	Mean Daily Area.	Wolt's Number.	Mean Solar Latitude of Spots
1923	55	5 8	$ \begin{pmatrix} 6^{\circ} \cdot 4^{*} \\ 24^{\circ} \cdot 4 \\ 22^{\circ} \cdot 7 \\ 20^{\circ} \cdot 2 \\ 18^{\circ} \cdot 6 \end{pmatrix} $
1924	276	16·7	
1925	830	44·3	
1926	1262	63 9	

<sup>\*</sup> Old cycle spots

t New cycle spots

The average provisional spot-number for the first six months of 1927 is 79, but since June the sun's activity has fallen off somewhat. Judging from the trend of the mean latitude of the spots—a fairly sure indication—the maximum year of the cycle should be 1928.

#### Research Items.

MEGALITHIC MONUMENTS IN THE MARIANAS -In the Scientific Monthly for November, Lieut.-Commander P J Searles describes the remarkable Lat'te or monuments composed of upright monoliths surmounted by hemispherical capitals, usually in two parallel rows of four to six stones in a row and running parallel to the seashore or a river bed The stones are of remarkable size Two of the largest monuments are in Timian. Their stones are eighteen feet in circumference at the base, and twelve feet high, the capitals being five feet high and six feet in diameter Each monolith weighs 30 tons In an unpublished manuscript of a Spanish Governor of the middle of the last century, it is stated that human bones were found in a hollow on the top of a monolith forming part of the 'House of Taga,' a chieftain who, according to tradition, buried his daughter on top of one of the monoliths Recent investigations indicate that the Lat'te were not dwelling-houses as has been thought, but monumental religious structures marking sites of ceremonies, cannibal feasts, and burnals. The mutilated condition of skeletons found in or near them points to canni-In Guam the Lat'te are connected with three areas, of which the first is the burial place, in which all the bodies are carefully orientated with feet to the water and head inland: next, an area devoted to warriors or the victims of cannibal feasts, as indicated by broken skulls, broken limbs, or weapons or parts of weapons embedded in the skeletons, thirdly, an area in which are found remains of ornaments, pottery, weapons, stone implements, etc. How the Lat'te were built is unknown, but in size and in the skill and industry required to build them they are comparable to Stonehenge

THE SCAPEGOAT IN INDIA —Although the custom of using the scapegoat as a means of expelling diseases is extinct or on the verge of extinction in most parts of India, Dr. Sunder Lal Hora has been fortunate enough to come across an example among the Gonds in the Bilaspore district of the Central Provinces. animal stuffed, and with its insignia, is to be exhibited in the Ethnographical Gallery of the Indian Museum, Calcutta. By careful investigation, a full account of the method of procedure was obtained and has been recorded in Journal and Proceedings of the Asiatic Society of Bengal, vol. 21, No. 3. When a disease such as smallpox is raging, the village resorts to the ceremony of Nikasi. A female goat is purchased by public subscription, and is adoined with ornaments usually affixed to the image of a goddess An anna is stuck in the middle of the forehead and near it six yellow spangles A string of yellow lac beads is placed round the horns, to which is attached a peacock's feather standing between the horns Beads of various colours, red and yellow predominating, glass bangles, and coloured threads are also used to ornament the goat. The significance of these rests in the fact that they are the ornaments of a goddess It is clear that in the course of the ceremony the goat becomes the goddess of the disease The disease is removed by the goat being passed on from village to village until she reaches her own temple or is devoured by wild beasts on the way.

EYESIGHT TESTING —The issue of the *Dioptric Bulletin* for September contains the papers read at the International Congress at Oxford in September last, organised by the British Optical Association, and is a volume of about 240 pages. Most of the 32 papers dealt with technical matters, but there were some of general interest dealing with eyesight tests. Dr.

F A Woll of New York gave the results of his tests of the evesight of 552 freshmen entering college in 1926. Of these, only 136 had normal vision, 156 had slight hyperopia, 32 wore glasses for it, and 35 more needed glasses; 122 wore glasses for myopia and 49 others needed glasses. Mr R O. Raphael gave an account of the work done by the Industrial Fatigue Research Board in demonstrating the relation between good sight and industrial efficiency of the workman. As examples he gave cases in which provision of suitable glasses raised the earnings of groups of employees 10, 15, and 27 per cent respectively.

Philippine Fishes.—The Sparoid and Rudder fishes of the Philippines are described by A. W. Herre and H. R. Montalban in the Philippine Journal of Science for August last. Four genera of the Sparidæ and two of the Kyphosidæ are found to occur, whilst the authors add four species of sea-bream to the records for those islands. Keys, accompanied by plates, are given for the identification of all the species, but it should be borne in mind that distinctions based on the colours of the fishes are very slender, and are to be avoided if possible. Members of both families are highly prized as food, and provide a basis for important hand-line fisheries in Japan and Formosa. The various species of sea-bream form one of the main sources of supply for a dried-fish industry carried on at Sitankai, in the Sulu archipelago.

A Thumb Claw in Fowls and Ducks—T Kageyama (Proc Imp. Acad Tokyo, July 1927) records the presence of a claw on the thumb in domestic fowls Out of 131 fowls examined, 111 had the claw on both right and left thumbs, 12 on the right thumb and 3 on the left, while 5 had the rudiment of a claw on both thumbs—Of 14 ducks observed, 12 had a well-developed claw on both right and left thumb. The presence of a claw is not therefore of rare occurrence, as is often supposed.

Size and Colour Inheritance in Impatiens—The inheritance of a character not frequently met with in flowers, namely, difference in size of certain petals, has been studied by B. S. Bedell, of the Imperial College of Tropical Agriculture, Trinidad (Gardeners' Chronicle, Oct 29, 1927) The species investigated was Impatiens balsamifera, and the characters selected were the size of the posterior lateral petal and the colour of the flower. The petal in question may be quite small, simply a small lobe overlapping the anterior petal, or it may be large or equal in size to the anterior. It has been found that 'smallness' and 'largeness' constitute a simple Mendelian pair of characters, with 'smallness' dominant and 'largeness' recessive, the characters segligating after crossing in approximately typical Mendelian proportions. In the case of colour, it has been shown that in the varieties dealt with there is a colour factor, in the absence of which the flower and stem become white and green respectively. If it is associated with a blueing factor, the flower will be purple, or if with a reddening factor, the flower will be scarlet, if both are present, in addition to the colour factor, the flower will be magenta.

Virus Diseases.—Probably the most important line of endeavour in plant pathology research at the present time is connected with investigations of virus diseases, which have also stimulated some interest in medical research circles on account of a possible analogy with cancer. The Agricultural Experiment

Station of the Michigan State College has just issued Bulletin No 80, on the virus diseases of raspberries, by C. W. Bennett. Five distinct virus diseases have been distinguished, and considerable experimental work has been done in investigating the aphids responsible for transmitting the diseases from plant to plant. Specimens of Aphis rubiphila were able to communicate the infection after being away from contact with infected plants for torty-eight hours. There is also considerable evidence to show that the same species can carry the virus and infect healthy plants after a period of more than three weeks. No evidence was obtained to indicate the presence of virus in the egg stage of the aphis. Girdling experiments on infected plants showed that virus failed to pass the girdled part, indicating that the virus moves in some part of the bark. The sieve-tubes would seem to be the most natural channels for such movement, which showed some evidence of a correlation with food translocation. The movement of virus through a plant seemed relatively slow, and some of the canes of diseased plants remained healthy until the spring following infection. Wide varietal range of susceptibility, apparent immunity and tolerance in relation to the different virus diseases, were found in the raspberry group

THE PHOTOGRAPHIC ACTION OF H-RAYS -Some applications of this method for studying H-particles are described by M. Blau in Communication No. 208 from the Institut fur Radiumforschung in Vienna. The best results were obtained with dental X-ray films, which after exposure at a large angle of incidence to protons from paraffin, showed well-defined linear sets of discrete spots, which were somewhat more widely spaced than if they had been produced by a-particles. The emulsion was sensitive to a number of the particles the residual range of which in air was less than 2 cm. The results with disintegration protons were less satisfactory, and were qualitative rather than quantitative, but a number of records were made with retrograde particles, which, it is claimed, support the general contentions of the Vienna school, and show in particular that the carbon nucleus can be disrupted.

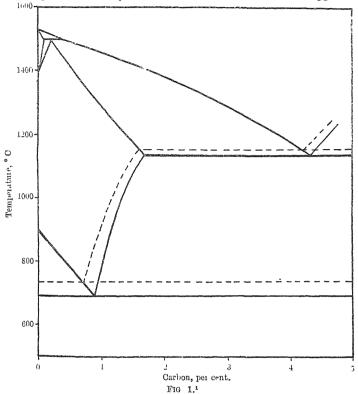
THE ELECTRON THEORY OF METALS -In an article in Die Naturwissenschaften of Oct. 14, Prof. A Sommerfeld points out that if Fermi's system of quantum statistics is adopted, the free electrons in a metal at room temperature are equivalent, so far as departure from classical theory is concerned, to a molecular gas which is almost at the absolute zero, and that this hypothesis leads to important modifications of the expressions for several of the properties of metals. conspicuous success of the application of this principle is the deduction of the Wiedemann-Franz relation between the electrical and thermal conductivities, with a factor of proportionality which is much closer to that found experimentally than that predicted by Prof. Lorentz for a Maxwellian distribution of energy. The constants of the thermo-electric circuit also prove to be at least of the right order of magnitude, although the formulæ from which they are obtained are very different from those used perviously, but the Volta series is the reverse of that found in practice. Prof. Sommerfeld considers that the weak point in his theory is the assumption—which is also inherent in most of the older work—that the mean free path is a purely geometrical quantity, determined by the space-lattice, but that in spite of this, the application of the new system of statistics has removed a number of discrepancies between theory and experiment, and should be capable of extension to other phenomena, amongst which he includes tentatively ferromagnetism.

PERMALLOY SUBMARINE CABLES. The use of permalloy, a material of high magnetic permeability, as a covering for the copper conductor of a long submarme cable has multiplied the signal speed attainable nearly ten times. In a paper by Mr. J. Gilbert, published ... m the Bell System Technical Journal for July, the results of laboratory experiments to determine the constants' of the lines prior to laying are described. When it is remembered that the actual cable when laid is subjected to a hydrostatic pressure which sometimes exceeds 10,000 pounds per square mch, it will be evident that measurements of the characteristics of the cable when subjected to this stress can only be made in the laboratory on a very small scale. The properties of the dielectric are affected by the pressure, and it is probable that the permeability of the permalloy is also affected. It is found that measurements of the capacity of the laid cable and the damping of the signals and their time of propagation, supplemented with laboratory measurements of eddy current losses, are sufficient to determine the four constants assumed in the mathematical theory, provided we know the relative resistances of the return paths for the signals in the sea water and in the armouring of the cable respectively. The experimental results make it highly probable that the electrical conductivity of the earth at the bottom of the sea is very much smaller than that of sea water Experiments on three laid cables are described, and the methods of computing their constants are discussed.

INCREASING THE LIFT OF AN AEROFOIL.—The work recently described by Prandtl before the Royal Aeronautical Society has apparently stimulated research of a very practical kind at Government research stations in Great Britain. Prandtl has shown that the state of flow behind a body moving in a fluid may undergo enormous change by withdrawing some of the fluid in the near of or on the boundary of the body when turbulence is setting in. In aerotoils it is very important if possible to increase the maximum lift coefficient This has been effected to some extent by the use of the Handley Page slot, whereby stalling is delayed to a much larger angle of incidence, and hence increased lift is obtained. It is known that the stall occurs when the stream lines break away from the upper surface of the aerofoil as a result of a reduction in energy under the viscous forces. In R. and M. No. 1100, on "Wind Tunnel Experiments on the Effect on the Maximum Lift of withdrawing and discharging Air from the Upper Surface of an Aerofoil," by Perring and Douglas (London: H M. Stationery Office, 1927. 6d. net), some experiments on an aerotoil are described where the air is discharged or removed from its upper surface. The aerofoil was fitted with slots along its span and provided with a means for measuring lift while air was discharged or withdrawn through these slots. By discharging air tangentically along the upper surface from a point near the leading edge a considerable increase in maximum lift is obtained, while a steady improvement occurred as the quantity of air discharged was increased. Similar results were obtained when the air was discharged into the aerofoil. The effect was dependent principally on the quantity of air concerned, and only to a minor extent on its velocity through the slot. The position and shape of the slot appear in this investigation to be very important, and better results are likely to be obtained in the near future. The importance of this investigation can scarcely be overestimated and if successful, it provides a striking illustration of the application of model hydro-dynanuc experiments to full scale practice.

#### A New Theory of the Cast Irons.

OF the papers submitted to the Iron and Steel Institute at its recent meeting on Sept 20-22 in Glasgow, one at any rate stands out as a contribu-



suggested that the carbide equilibrium is the stable one. Prof Hanson has now considered the results which would follow from a change over from one system to the other as the temperature is varied. If, for example, graphite is the stable form at temperatures up to, say, 1000° C and carbide stable at higher ones, then the dotted line separating the austenitic phase from one in which free graphite or carbide also exists must cross the ordinary cementite line at that temperature, and thence onwards up to the solidus will lie to the right. As a result, a type of diagram similar to that of Fig. 2 will be found. It is, perhaps, right to point out that although the advance copy of Prof.

the dotted lines in the figure represent, therefore, the

graphite equilibrium. Alternatively, Rosenham has

forward by Honda

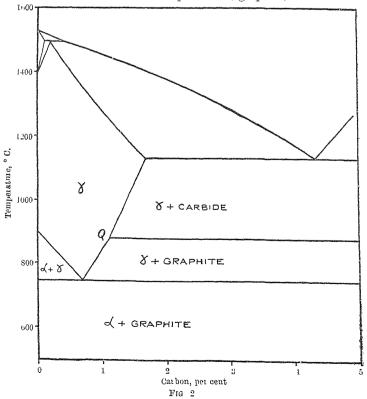
The normal cast irons and steels are not, however, pure binary alloys and represent sections through at least a ternary model, silicon being for the present purpose the most important addition. Where the amount of this is insufficient to cause the introduction of a new phase its effects upon a diagram such as Fig 2 are considered, and in the light of the experimental evidence obtained, it is shown that these results can be represented completely by a diagram of the form of Fig 3 and by no other

Hanson's paper does not refer to the fact, some such suggestion has already been put

It is yet too early to say how completely the new hypothesis and diagram fit in with all the established facts regarding the relationships of iron, graphite, and carbide.

tion of far more than usual interest. Carbon may exist in the unhardened irons and steels in the free state, in all probability as graphite, or combined with the iron as the carbide  $Fe_3C$  In the steels the latter form is almost invariably the one present, while in the grey irons it is graphite. The relationship of these two forms has been by no means cleared up, though in general it has been assumed that in the stable condition the solid material would contain the carbon in the graphitic form, the carbide being a metastable constituent This is represented in thermal equilibrium diagrams by super-posing the one for the graphitic metal upon that for alloys containing carbide. This double diagram has been admittedly incomplete and unsatisfactory, and a noteworthy contribution is made to the subject by Prof. D Hanson, who, on both experimental and theoretical grounds, now offers a single diagram in which phase fields are deliminated in which both types of carbon are to be found.

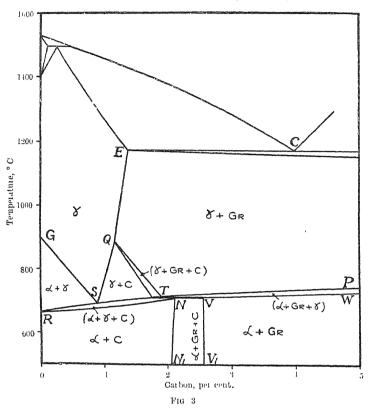
The most generally accepted diagram, that in which both the iron-carbon and the iron carbide equilibria are independently shown suggested by Roozeboom, Benedicks, and others, is shown in Fig 1.1 Graphite is represented as the stable phase at all temperatures below the solidus, and



<sup>1</sup> This and the other illustrations are reproduced by courtesy of the Iron and Steel Institute.

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Certain facts regarding the presence of graphite in carbon steels, particularly those which have been cold worked, do not appear to be altogether in accord with the new ideas, but this is probably merely a question of the exact position of the limits of the phase fields. To Dr. Hanson the credit is due for opening up



possibly an almost undreamed-of simplification of existing notions concerning these hitherto very complicated materials.

F. C. T.

#### Aeronautical Research in Great Britain.1

THE steady advance which has shown itself in all aspects of aeronautical research since the inception of the Aeronautical Research Committee is marked by the appearance of the report for the year 1926-27. It is a standing tribute to the work which may be done by a team of steady, earnest workers marshalled in their activities to a definite end.

It is difficult to separate out the investigations by placing them in separate categories, for a considerable amount is of a general nature and overlaps into several fields. Broadly speaking, however, the work of investigation deals with aerodynamics, airships, engines, and materials, but each of these is itself a composite group.

There are numerous papers dealing with the measurement of performances of aeroplanes, especially with the newer method introduced at Martlesham, by Lieut. Capon. In air-screws the impact of the Lanchester-Prandtl theory of fluid motion makes itself apparent in a series of papers by Glauert and Lock. Here a difficult subject is being pushed

1 "Report of the Aeronautical Research Committee for the [year 1926-27." (London: H.M. Stationery Office, 1927) 23. net.

several stages further—A problem to which members of the research staffs concerned have devoted close study is that of generation and avoidance of spinning in aeroplanes, and this year sees the production of a considerable volume by Gates and Biyant, where the whole of the subject is discussed in the form of a

special monograph. For those who strive to retain contact with this rapidly developing subject, this new departure by the Aeronautical Research Committee of summarising in this form at stages the work which has been accomplished is to be highly commended. The further development of the subject by the complete representation of a spin in the wind tunnel is progressing. It is hoped that this work, in conjunction with detailed records of the motion of spinning aeroplanes taken at the R.A.E., will cluedate those points which are still obscure.

The suspicion that recent aeroplane accidents have been associated with wing flutter has constrained the Committee to set up a special section for the investigation of this problem. At the National Physical Laboratory, Teddington, it is now possible to demonstrate at will various types of flutter that have been experienced in flight. The problem of determining the aerodynamic characteristics of aircraft during flutter is still the subject of investigation, but certain recommendations for the avoidance of dangerous vibrations in future aircraft have already been put forward, and modifications to existing types of aeroplanes exhibiting this phenomenon have been suggested with the view of its suppression.

A new departure is seen in the development of a tailless aeroplane by Captain Hill While various experimental difficulties had been experienced with the

lightly loaded aeroplane of this type, these have now been overcome, and some development may be looked to in the near future. It is reported that this aeroplane is quite stable and controllable in flight at large angles of meidence.

On the purely scientific side, some interesting experiments are detailed on the two-dimensional airflow behind a flat plate inclined at various angles. Studies are made of the frequency and velocity with which the individual vortices pass down stream and measurements are made of vortex strength. The results show a very fair agreement with Karman's formula, the longitudinal spacing of the vortices remaining constant for a distance of several plate widths down wind.

Meanwhile, at Cambridge, an experimental water-tank has been erected, in which two-dimensional bodies are towed through water. By this means a Reynolds' number of approximately  $10^4$  has been obtained, and it is hoped to produce results shortly with numbers so high as  $5\times 10^5$ . Thus an approach is being made to the corresponding number for normal flight, namely,  $3\times 10^6$ .

While stress has here been laid on the aerodynamic side of this year's report, this is done merely to indicate the kind of advance which shows itself in all the other sections under the influence of systematic and co-ordinated research work. As an experiment in organised research, the Aeronautical Research Committee may in many respects be taken as a model.

#### University and Educational Intelligence.

Cambridge.—Mr W. Dawson, Gonville and Caius College, has been re-appointed reader in forestry Mr. T. M. Harris, Christ's College, has been appointed demonstrator in botany.

A COURSE of twelve Swiney lectures on The Geological History of Scotland will be given by Dr. R Campbell in the lecture theatre of the Imperial College of Science (Royal College of Science), South Kensington, at 5 30, on Dec 12, 14, 16, 19, 21, 23, and Jan 2, 4, 6, 9, 11, and 13 Admission will be free

The following travelling fellowships for women graduates, for the academic year 1928–29, are included among those announced by the British Federation of University Women, Crosby Hall, Cheyne Walk, SW 1, from the secretary of which application forms and regulations may be obtained. The Rose Sidgwick Memorial Fellowship, value £400, for research work in the United States, to a British woman graduate (latest date of application, Feb. 15). An International Junior Fellowship, value £250 (offered by the International Federation of University Women), for research in biological or physical science, or in mathematics (latest date of application, Feb. 15).

It may be remembered that a committee composed of representatives of teaching and industrial bodies and learned institutions was formed in 1925, under the chairmanship of the late Right Hon Loid Emmott, to inquire into the relationship of technical education to other torms of education and to industry and commerce A report embodying some of the chief results of the committee's investigations was discussed at a meeting held in the Regent Street Polytechnic, London, on Nov. 18, under the chairmanship of Sir Robert Blair. The report was approved, and it was agreed that it be submitted to the President of the Board of Education The following deputation was appointed to wait upon the President of the Board of Education in this connexion: Sir Robert Blair, Sir Benjamin Gott, Mr W Prescott (Federation of British Industries), and Mr J. Wickham Murray.

The annual meeting of the Geographical Association will be held at the London School of Economics, Houghton Street, London, W.C.2, on Jan. 4-9 Dr. Vaughan Cornish will deliver his presidential address, "Harmonies in Scenery," on Jan 7; the address will also be broadcast from 2LO by Dr. Vaughan Cornish on Jan. 9 Lectures have been arranged by Dr Marion 1 Newbigin on the geographer and the study of climate (Jan 5), Sir John Russell on Palestine and its agricultural possibilities (Jan. 5), Prof. Rodwell Jones on the prairie provinces of Canada (Jan 6), and Sir E. Humphrey Leggett on economics and administration in British East Africa (Jan. 7). On Sunday, Jan. 8, the Rev. Canon C. S. Woodward will preach at Evensong in Westminster Abbey on "International Relations in the light of Geographical Science." Visits to the Imperial Institute and to demonstrations of educational films are being arranged, and a publishers' exhibition will be open on Jan 5-7. All communications regarding the meeting should be addressed to the honorary secretary, Prof. H. J. Fleure, 11 Marme Terrace, Aberystwyth.

#### Calendar of Discovery and Invention.

December 11, 1691.—Prior to the use of steam for pumping engines, experiments were made on the employment of gunpowder for the production of motive power. In the "Calendar of State Papers" is the following entry "Decr 11th, 1691—Wariant for a grant to Sir Samuel Morland of the sole use for 14 years of his invention for raising water out of pits, etc., to a reasonable height, by the force of powder and air conjointly."

December 11, 1863.—In 1838 two English chemists, Dyar and Hemming, patented a process for producing carbonate of soda by the action of ammonium bicarbonate upon sodium chloride, but all attempts to manufacture by this process failed until the Belgian chemist. Ernest Solvay, devised modifications in it which were patented by him in England on Dec. 11, 1863. With his brother Alfred, Solvay started works near Brussels in 1866. In 1873 a hience was granted to Brunner and Mond, and by 1914 there were throughout the world 23 separate works engaged in the Solvay ammonia-soda process capable of producing nearly 2,000,000 tons of soda-ash annually.

December 12, 1901.—It was on Dec 12, 1901, in a room in a disused barracks on Signal Hill, St Johns, Newfoundland, that Senatore Marconi heard faintly in a telephone the groups of three dots, constituting the morse letter S, transmitted from Poldhu in Cornwall. The detector used was a self-restoring coherer and the aerial a thin wire carried to a height of 400 feet by a kite. One feature of the experiment was that its success disproved the theory then widely held, that the transmission of radio signals over great distances would be impossible owing to the curvature of the earth.

December 14, 1874.—On this day Cornu communicated to the Paris Academy of Sciences the result of his redetermination of the velocity of light. His methods were fundamentally the same as Fizeau's, but his precision was greater

December 15, 1859.—One of the landmarks in the history of the spectroscopic examination of the sun was the memoir read by Kirchhoff to the Berlin Academy of Sciences on Dec 15, 1859, in which he explained the nature of the lines in the solar spectrum

December 15, 1904 —Though attempts were made' from time to time to elect women into the Linnean Society of London, it was always found that the original charter did not permit this being done. A supplemental charter was therefore obtained in April 1904, and the first election of women as fellows took place on Dec. 15 of that year

December 16, 1883.—To Gottlieb Daimler we owe the first high-speed internal combustion engine with high compression, which he patented in Germany on Dec 16, 1883

December 17, 1849 —The well-known form of pressure gauge with the curved tube of elliptical section was invented by the French engineer Bourdon and patented by him on Dec. 17, 1849 —He was led to the invention by observing the motion of the end of a coil of copper pipe when being tested.

December 17, 1903.—The pioneering work of the Wright brothers, leading to the construction of the first practical flying-machine, was spread over the years 1896-1903: and it was on Dec. 17, 1903, on the lonely sandhils at Kitty Hawk, North Carolina, U.S.A., that the brothers made their first flights. Orville Wright flew first for 12 seconds, and the same morning Wilbur Wright flew for 59 seconds

#### Societies and Academies.

#### LONDON

Geological Society, Nov. 16 - W D. Lang, L F Spath, L. R. Cox, and Helen Marguerite Muir-Wood. The belemnite-marks of Charmouth, a series in the Lias of the Dorset coast—Pale marls, lying in the Lias above beds with Echioceras and below those with Androgynoceras, extend along the Dorset coast for about four miles Forming the third, and highest, Lias precipice on Black Ven, they are soon truncated by the eastern slope of that clift, but reappear eastwards to form the second precipice at the western end of Stonebarrow Cliff. They descend to the beach at Westhay Clift, and form a gentle syncline, so that the lowest beds are carried beneath the tide opposite Westhay Water They rise for a short distance on Ridge Cliff, but soon are thrown down and out of sight by the Ridge Fault. Thereafter only the highest beds of the belemnite-marks are seen. The marks contain few beds in which ammonites are well preserved. Ammonite-remains, however, are to be found throughout, and although the preservation is often poor, a sequence has been established. Except at a few horizons, belemnites are not common below the belemmite-marls, but they abound in the marls, and, if the outstanding forms are carefully collected, they show, like the ammonites, limited ranges and a crowded sequence. The gastropod molluses are few in number of species and not suitable for showing zonal distribution. The same may be said of the lamellibranchs. The ammonites are only of local value in establishing a sequence.

Royal Meteorological Society, Nov. 16.- (' E. P. Brooks. The influence of torests on rainfall and run off. Of the water vapour which is condensed as rainfall over the land, about two-thirds is provided by evaporation over the oceans, and the remaining third by evaporation and transpiration over the land. The latter contribution is made up of the evaporation of rainfall intercepted by foliage, evaporation from the soil, and transpiration. As percentages of an average rainfall of 30 mehes a year, the amounts are (a) for forests: interception 15, evaporation from soil 7, transpiration 25; (b) for crops evaporation from soil 17, transpiration 37; (c) for bare soil: evaporation 30 per cent. Thus replacement of forests by crops tends to mcrease the supply of moisture to the air, and therefore the general rainfall slightly; replacement by bare soil would decrease the general ramfall slightly Replacement of forests by crops would decrease the run-off by 15 per cent, and make it less regular; replacement by bare soil would increase the run-off but would make it highly irregular. A forest 30 teet high adds about 30 feet to the effective height of the ground, and this should merease the local orographical ramfall by one or two per cent At Mauritius, deforestation has resulted in a decrease by two or three per cent, while in Sweden, Germany and India the rainfall at forest stations is about one per cent. greater than that at neighbouring stations in the open. Under average conditions the total effect of fog and dew is slight.—C K M. Douglas. The secondary depression on the night of January 28-29, 1927. The discontinuities associated with this intense and deepening secondary depression were examined in detail by means of autographic records at a number of stations. About 70 miles behind the first cold front there was a 'dry front,' with a rise of temperature and sharp fall of relative humidity, separating air kept cold and damp by the rain, and air behind the rain area which had been warmed at

the dry administerate when it descended. Near the centre of the secondary depression a 'secondary warm sector' was developed after the original warm sector was 'occluded,' re displaced entirely from the lower layers of the atmosphere E. Kidson. The circulation of the atmosphere over Melbourne. It is possible to obtain estimates of wind velocity at high levels by means of nephoscope observations with accuracy sufficient at least for most purposes. No other means is at present available for securing a comparable amount of data for the same levels in a clunate such as that of Melbourne. These upper winds are freed from the purely local effects, though large-scale local effects are still of great importance.

Linnean Society, Nov. 17--N. E Brown The South African species of Iridacea in Thunberg's herbarum Carl Pehr Thunberg was born in 1713, and in due course became a pupil of Linné, and afterwards professor of botany at Upsala. He sailed from Europe on Dec. 30, 1771, and landed at Cape Town on April 17, 1772, the journey occupying fifteen weeks. Thunberg stayed in South Africa nearly three years, and sailed to Java on Mar. 2, 1775 During his stay he made three extensive journeys, and in two of them was accompanied by Francis Masson, who was sent to collect living plants for the Royal Botanic Gardens at Kew. Thunberg sent or brought back from the Cape a large collection of dried plants and described them in numerous separate pamphlets and in his "Prodromus Plantarum Capensium" and "Flora Capensis."—A. W Exell: Some hybrids of Cotoncaster frigida Wall. Various hybrids of *C. fragida* Wall, have arisen at the Bagshot nurseries of Messrs-Waterer, Sons and Crisp. One or two of these are of considerable horticultural value. George Matthai. Exhibition of photographs and drawings of recent Meandroid Astreid corals. The photographs represent nearly all the known species of recent Meandroid Astraids, and refer to material collected from the Indo-Pacific (including the Red Sea) and the Atlantic regions as well as to type-specimens m the European and American museums. They were taken with the view of showing the probable limits of \(^4\) genera and species, the range of skeletal variation within each species, the appearance of the soft parts and of stages in the growth of colonies, and illustrate, for the first time, many of the types of previous authors The drawings are illustrative of the histology of polyps after decalcification, and have been made from serial sections. The plates will accompany a forthcoming monograph in which a revised classification of the group is made from a comparative study of their hard and soft parts and of existing type-specimens.

#### CAMBRIDGE.

Philosophical Society, Oct. 29.—4. C. Steward: On the lens interferometer. The lens interferometer offers a method of examining the aberrations of an optical system by means of the interference tringes given by a wave of light which has passed through the system—which therefore is distorted by the aberrations impressed upon it—and an 'ideal' wave which would be given by a 'perfect' system. An examination is made of the various types of fringes to be expected in the presence of the different geometrical aberrations of the symmetrical optical system. The basis of the investigation is an 'aberration function,' previously introduced, associated with the characteristic function of Hamilton. This aberration function sums up in itself all the geometrical aberrations of the optical system and depends upon these aberrations alone.—J. A. Gaunt and W. H. M'Crea: The emission of radiation by a quadripole electric moment on the quantum mechanical.

theory of dispersion is adapted to calculate the radiation from the quadripole moment of a system applied to the quadripole radiation of a Planck oscillator ( $\Delta n = 2$ ) and to the case of a rotating rigid homopolar diatomic molecule—G. H. Aston. The amount of energy emitted in the  $\gamma$ -ray form by radium E A method of finding the order of magnitude of the small amount of energy emitted in the  $\gamma$ -ray form by radium E is given. The method involves a comparison of the ionisations of the  $\gamma$ -rays of radium E. radium B, and radium C. The energy is also estimated in another manner, and the two methods agree in showing that the  $\gamma$ -ray energy is of the order of I per cent. of the  $\beta$ -ray energy, i.e. about 3000 volts per atom disintegrating Only one  $\gamma$ -ray quantum is emitted in about thirty disintegrations, and it is suggested that this  $\gamma$ -radiation has a continuous spectrum —W H M'Crea: (1) The specific heat of water vapour and the theory of the dissociation of water vapour at high temperatures. The elementary (quantum) theory of the specific heat together with dissociation accounts quite satisfactorily for the observed specific heat of steam. The dissociation theory is applied in such a manner that it also checks the observed values of the dissociation and enables one to estimate certain molecular constants from them. The range of temperature considered is about 100° C.–2000° C (2) The specific heat of carbon dioxide and the form of the CO2 molecule Neither the linear nor the triangular model hitherto given for the carbon dioxide molecule accounts properly for the observed specific heat curve. A hypothesis on which the molecule changes from the first to the second form when a certain vibration becomes excited is suggested. It gives better agreement for the specific heat and seems to explain some anomalies of the band spectrum. The effect of the interaction between vibration and rotation on the specific heat at high temperatures is considered.

#### PARIS.

Academy of Sciences, Nov. 7-H. Deslandres: Contribution to researches on the secondary spectrum of hydrogen and also on other spectra. The strongest hands of this spectrum appear to be due to the molecule H<sub>3</sub>, already proved to exist by J. J. Thomson with the mass spectrograph -C. Matignon and J. Calvet. The chemical properties of pure aluminium. Commercial aluminium, purified by Hoope's electrolytic method, ontains from 99 8 per cent. to 99.98 per cent of aluminium. Solutions of caustic soda attack commercial and purified aluminium similarly, and the two cannot be distinguished by attack with this reagent The purified metal, however, is very resistant to attack by hydrochloric acid (2.65 normal). -Pierre Termier: Some results of the Congress of the Carpathians Association held at Bucharest in September 1927.—A. Kolmogoroff: The law of large numbers (theory of probabilities).—R. Risser: A formula representing the living population. A modification of Altramare's formula on the probability of life.-B. Gambier: Contact of skew curves. The theorem of Meusnier and generalisations. The intrinsic equation of a surface -Richard Birkeland: A general proposition on hypergeometric functions of several variables.—Mandelbrojt. A recent work of Widder and Gergen.—Edm. Lahaye: The application of a new method of integration to the equations y' = R(x, y)where R is rational in y—Félix Leprince-Ringuet: The properties of wire cables [pit shaft] deduced from statistics, trials, and results obtained in use.—J Grialou. Plane vertical rotational movement of perfect liquids. Flow through an orifice.—Th. de Donder. The problem of n bodies in the theory of relativity —Georges Henri Huber: The influence of surfaces of atmospheric discontinuity on the propagation of short [radio] waves.—J. Risler. The phenomena of gas absorption and equilibrium of pressure in lamps without filament. The introduction of a small quantity of anthraquinone into a two electrode valve, used as a rectifier, maintained a pressure of about 0 1 mm. The efficiency of the rectifier remained steady for several hours.—C. Mihul· The structure of the spectrum of O II —Emilio Damour and A. Thuret: The determination of the temperatures of commencement of fusion and of tempering of industrial glass -Vasilesco Karpen · Batteries with non-attackable electrodes -G. Athanasiu The radioactivity of the warm springs of the Bains d'Hercule, Roumania -Fred Vies and Mile Madeleme Gex: The optical properties of sulphonecyanine in different saline solutions and their application to the comparison of salts-L Abonnenc: The surface tension of aqueous solutions of acids.—Mlle M Pernot. The system mercuric iodide, potassium iodide and water. No evidence has been obtained of the salt  $\mathrm{HgI}_2\mathrm{KI}$ .  $\mathrm{2H}_2\mathrm{O}$ . The only crystalline species indicated by the diagram is  $\mathrm{HgI}_2\mathrm{KI}$ ,  $\mathrm{H}_2\mathrm{O}$ —Ch. Quillard Measurement of the oxidisability of aluminium and its commercial alloys after activation with mercuric chloride. The metals were treated with mercuric chloride solution, washed, rapidly dried, introduced into a calorimeter and the rise of temperature noted. It is shown that the method will serve for the rapid differentiation of aluminium alloys from the point of view of their corrodibility.—Amand Valeur and Paul Gailliot . The mechanism of the reactions accompanying the formation of Cadet's oil. The effect of heating a mixture of potassium acetate and arsenious acid gives a complex liquid the starting-point of which may be regarded as methylarsenic.—E Raguin: Antestephanian transport phenomena in the substratum of the crystalline strata of the great coal ridge of the French Central Plateau.—G. I. Verescagin: New studies of Lake Baikal.—Joseph Lévine: The rôle of ozone in the atmosphere.—Henri Coupin. The introgen nutrition of *Penicillium glaucum*.—Pierre Lesage. The precocity and final yield in the thermobiology of plants and variations with latitude.—Lucien Daniel: The variations of descent in grafted Jerusalem artichokes.

—Costantino Gorini · Dysgenesic milks

#### CALCUTTA.

Asiatic Society of Bengal, Nov. 7.—H. Bruce Hannah: Indian origins. It is suggested that the old Dasyus of Sapta Sindhavah introduced Nature worship into northern India in Vedic times; that they became the Brahmans of Kuruland; that Taxila was a city of theirs; and that the 'finds' recently made at Harappa and Mohenjo-Daro were Dasyuan and have nothing to do with Sumer.—W. Ivanow: Notes on Khorasanı Kurdish.—Mrs. C de Beauvoir Stocks: The Khyber Hazari. This tribe inhabits the Lolab valley in Kashmir, but their original home is in the Hazara district to the east of Afghanistan.— R. D. Banerji. The Indian affinities of Ainu potteries. Three types of Ainu pottery discovered among the shell mounds of the sea coast of north-eastern Japan and preserved in the Museum Shoshu-Kan, show a marked resemblance to Indian prehistoric pottery of the Copper Age. The first of these is a suspension vessel, numerous examples of which have been discovered in Baluchistan, Mohenjo-Daro and Harappa. The second is a 'wine cooler.' Such vessels with handles have been discovered in Japan and Baluchistan and without handles in Taxila and Baluchistan. The third type is a bird-shaped vase, numerous examples of which have been discovered at Mohenjo-Daro and Harappa. It resembles the famous dove-vase from

Knossos.—D. N. Majumdar · A few types of Ho Songs—C. J. George: South Indian Aphididae The results of a preliminary survey of the aphid fauna of South India, with special reference to the species found in the neighbourhood of Combatore, is given. This is a first step towards devising control measures against plant lice in those parts.

#### Rome.

Royal Academy of the Lincei: Communications received during the vacation —J Hadamard and E. Landau · Entire functions of finite species —C. Foà · The neurochemical mechanism of vagal inhibition in the heart of mammifers. Further experiments show that, in the heart of mammifers, vagal inhibition is accompanied by liberation of a substance of inhibiting effect, and that this is probably destroyed rapidly in the texture of the myocardium where it is produced and does not pass into the coronary reflux cucuit unless the conditions of permeability of the cardiac fibre are altered, for example, by sprinkling the isolated heart with Ringer-Locke solution.—A. Russo · Attenuation of the sexual power of the impure gametes which accomplish the second accessory conjugation in Cryptochilum echini —L. A. Herrera: Imitation of organised forms by means of sodium stearate. Further experiments, with ordinary petrol and sodium stearate, confirm the importance of the fatty acids in morphogenesis -R. Caccioppoli: Multilmear and higher degree functionals.—G. Krall: Infinitesimal variation of Green's functions relative to pluri-connected plane fields.—R Mazet: Complements to a note on the oscillation of a liquid in communicating vessels.—G. Thomsen. The rotation of the earth in relativistic mechanics.—A. Merola: Photometric observations of the new variable in the constellation Auriga.—M Baruzzi: Periodic courses of the mean diurnal temperature at Modena—F. Eredia: The resultant direction of the wind at various altitudes deduced from observations of pilot balloons at Vigna di Valle (Bracciano).-F. Rasetti: The intensity of a prohibited potassium line. Investigation of the anomalous dispersion by Puccianti's method gives for the doublet  $4^2S - 3^2D$ ,  $\lambda 4642$ , of the potassium spectrum a number of dispersion electrons one million times less than for the first doublet of the principal spectral series, λ7665, 7699.—A. Ferrari: Crystalline structure of the bivalent chlorides. Anhydrous cobalt and nickel chlorides. These chlorides exhibit the same structure as magnesium chloride, being rhombohedral and pseudo-cubic. The rhombohedra constituting the elementary cells contain 16 molecules and have for a the following values: MgCl<sub>2</sub>, 10·16; CoCl<sub>2</sub>, 10·02; NıCl<sub>2</sub>, 10·00 A. The calculated densities are respectively 2·41, 3·43, and 3·45—L. Mascarelli: Contribution to the knowledge of diphenyl and its derivatives. Interpretation of the plane of the plane of the contribution of the contribution of the contribution. derivatives. Interpretation of the phenomena of optical isomerism. Of various diphenyl derivatives examined, only 2: 2'-diamino-6: 6'-dimethyldiphenyl appears to be resolvable into optical antipodes. This compound was obtained by treating 2-iodo-3-nitro-toluene with powdered copper and reducing the resultant 2: 2'-dinitro-6: 6'-dimethyldiphenyl. Under the action of d-tartaric acid it gives a sparingly soluble salt which is converted by ammonia into a lævorotatory isomeride of the original compound.—A. Desio: The Miocene molluscs of Porto Bardia and of the oasis of Giarabub.—M. Piazza: The presence of scorodite in certain tungsten minerals of Portugal.— E. Seren: Investigations on the chromatophores of the cephalopods. Experiments on Octopus vulgaris, Eledone moschata, Loligo vulgaris, Sepia officinalis, Sepiola elegans, etc., show that, with gradual heating, a certain exaltation of the pulsatory activity of the chromatophores often appears between 25° and 30°, this being followed, at 37°-39°, by a general and reversible expansion. On the other hand, on cooling, complete retraction of the chromatophores is observed between 10° and 5°, and evident diminution of the electrical excitability below 5°. The chromatophores exhibit only slight sensitiveness to variations of the osmotic pressure. As regards the influence of various cations, both the alkali metals and those of the alkaline earths have a contracting effect; with the former, this is greatest for potassium and least for sodium, and with the latter, greatest for barium and least for magnesium.—G. Cotronei Time of development of the humoral-nervous correlations. Investigations on amphibia

#### SYDNEY.

Linnean Society of New South Wales, Aug. 31 .-J. R. Malloch. Notes on Australian Diptera (12). This part deals with the family Tachinidæ. new genera and four new species are described. Keys to genera and species are given with many useful notes.—I M. Mackerras: Notes on Australian mosquitoes (Diptera, Culicidæ). Part 2. The zoogeography of the subgenus Ochlerotatus with notes on the species. In this part, evidence is brought forward to support the opinion that both groups of this subgenus of Aedes colonised Australia from South America, one entering this country from the north and the other from the south. A key to adult females is given and the status of the various species is discussed. One species and one variety are described as new.—A. G Hamilton. The xerophytic structure of the leaf in the Australian Proteaceæ. Part I. The author gives a general account of the methods adopted by the Proteaceæ to lessen transpiration, and points out that several recognised devices are not found in the order, as leaflessness, bloom, wax or varnish, hygroscopic salts, and ethereal oils Hairiness, too, is not developed to the extent it is in the South African Leucadendron, although many of the Grevilleas and Banksias have densely hairy undersides to the leaves The conditions leading to xerophylly are discussed, and the view expressed that the main factor is the edaphic conditions. From the fact that favourable conditions do not lead towards the mesophytic form, it is surmised that the xerophytic characters have been so long fixed that no alteration is possible. The structure of the flat-leaved Hakeas is then described, several remarkable modifications being noted. One of the most striking features is the enormous development of sclerenchyma (columnar, detached masses, and fibrous).—G. A. Waterhouse: Australian Hesperudæ. Part 1. Notes and new Australian Hesperudæ. Part 1. Notes and new subspecies. In this paper an alteration of the sequence of the genera in the subfamily Trapezitinæ is given, a new species allied to Hesperilla crypsargyra is described and figured, new subspecies of H. donnysa and H. chrysotricha, and the hitherto unknown female of Toxidia crypsigramma are described and figured.

Royal Society of New South Wales, Oct. 5.—R. H. Cambage: The vertical growth of trees (2). Nails were placed one foot apart in young trees of various species of Eucalyptus, Angophora, Acacia, and Grevillea From four to eleven nails were inserted, and though some trees increased their length by 50 per cent. in five years, and one by 160 per cent in one year, there was practically no extension of the stem up to the highest nail, but the trees grew from the summit or growing-point.

#### Official Publications Received.

The Economic Proceedings of the Royal Dublin Society Vol 2 No 20 The Influence of Separation and Payteurisation of the Size and Distribution of the Pat Globules in Milk and Grain By Doromy A Beckett Pp 808 317+1 plate (Dublin, Hodges, Figgis and Co., London Williams and Norgate, Ltd.) 1.

Department of Agriculture, Januaca Entonological Bulletin, No 4, Parts 1 and 2 Catalogus Insectional Januaces, S. By C. Coondey Pp. 11-114-xiv-10-in (Jamaica, B.W.I. Goternment Printing Office Kingston) 25

Beckett Pp 300 317-1 plate (Dublin, Hodges, Figgis and C., London Williams and Norgate, Ltd.) 15
Department of Agriculture, Januaca Entomological Bulette, No. 4, Parts 1 and 2 Catalogus Insectorum Jamucests. By C C Goadey Pp 11-114-xiv-10-10 (Januaca, B W II Government Printing Office, Kingston) 25
Treatment of lubeloxicosis Costs at Residential Institutions. (Methodic, Kingston) 25
Treatment of Inbeloxicosis Costs at Residential Institutions. (Methodic, Williams) 20
Melboarne Observatory Hourly Values of the Magnetic Elegents at Toolangi in 1925
Observed and reduced under the direction of Di J. M Baldwin. Pp viii+37 (Melboarne-H J Green)
Commonwealth of Australia Council for Scientise and Industrial Research Bulletin No. 23
The Possibilities of Power Airc'd and certain other Fuels in Australia. By G A Cool. Pp 100 (Melbourne H J Green)
British Protographic Research Association Report for the Year 1920-17
Proceedings of the Society of Psychical Research Part 103, Vol 36, November. Pp 515-70 (London Fignes Edwards.) 4s ret.
The Journal of the Institution of Electrical Engineers Edited by F F Rowell Vol 53, No. 371, November. Pp 777-1024-cval (London E and F N Spor, Ltd.) 10. M/
Government of India Department of Lubarnes and Labour (Public Works Branch) Irrigation in India Review for 1025-26. Pp 104-37 (Simila Government of India Press Science, Halliams and Transactions of the Nova Scotta Institute of Science, Halliams and Transactions of the Nova Scotta Institute of Science, Halliams and Transactions of the Nova Scotta Institute of Science, Halliams and Transactions of the Nova Scotta Institute of Science, Halliams and Transactions of the Nova Scotta Institute of Science, Halliams and Transactions of the Nova Scotta Institute of Science, Halliams and Transactions of the Nova Scotta Institute of Science, Halliams and Transactions of the Work and Proceedings, Philosophical Transactions of the Royal Society of Lonion Science Philosophical Transactions of the Royal Society of Lonion Science Philosophical Transaction

Spain) 5s Imperial Department of Agriculture for the West Indies Report on the Agricultural Department, St. Vincent, for the Year 1920. Pp. 11+37 (Trimdad, B.W.I.) bd The National Institute of Agricultural Botany. Eighth Report and Accounts, 1926-27. Pp. 20. (Cambridge.)

#### FOREIGN

Proceedings of the United States National Museum Vol 72, Art 15.
The Australian Land Shell, Thersites Inpartita, and its Allies By William B. Marshall (No. 2711) Pp 16+2 plates Vol 72, Art 17.
On some Terrestrial Isopods in the United States National Museum By Hans Lohanarder (No 2713) Pp 18 (Washington, D C Government Process Processed Process

By Hans Lohmander (No 2713) Pp 18 (Washington, D.C. Government Printing Office)
Steriges Geologiska Underschning Str. Ca. No 19 Die Zoantharia Rugosa von Gotland (Bes. Nordgotland) nost Benierkungen 2007 Biostraugraphie des Gotlandium. Von Prof. Dr. R. Weiekind. Pp 95+30 Tafelin. 8 kr. Ser. Ca. No 20 Strässa och Blanka Jarimalinsfalt Geologisk Beskrittining. Av Per Genier. (Summyr. The Iron Ore Fields of Strässa and Blanka.) Pp 48+5 Taylor. 5 ki. (Stockholm.) Publications of the Astronomical Observatory of the Warsau Unversity. Vol. 2, Part 2. Determination of Landide by the Method of Equal Altitudes of Different Stars (Piewaow's Method) and the Corresponding Star-Pairs for Northern Latitudes 20-25. Part 2. The List of Stars. By Prof. M. Kamieński. Pp 44 (Warsaw.)

Steriles Geo ogiska Undersolving Ser C. No. 340. Ortrasket och dess tapt ingekatastrofer. Av G. Lundquist. Pp. 56+1 Tavla. 1 kr. Ser C. No. 341. Jordshalv i Svenie Pole-1025. Av K. E. Sahlstrom. Pp. 34+1 Tavla. 1 kr. Ser C. No. 342. Brattforsleden, ett. varmingski randucitelkompiex och dess gyper. Av N. G. Horner. Pp. 208+2 Tavlo. 2 kr. Ser C. No. 343. Some Mineral Associations from the Norberg Destrict. By Per Genjer. With Analyses by Artur. By 200. Pp. 52. 1 kr. Ser C. No. 344. Ancyuse och Litorinagranser more geologiskal larthaad-t Gesain. Av Gunnar Assarsson. Pp. 20+1. Tavla. 1 kr. Ser C. No. 345. Klassi kation ev svenska åkerjordar. Av Gunnar Ekstrom. Pp. 161. 2 kr. (Stockholm.). Agricultura and Appliel Socie ee. Special Bir ston. No. 164. Diagnosing Ormand Lib. By V. R. Gardner, R. H. Pettit. C. W. Bennett and W. C. Lutton. Pp. 70+8 plates. Special Buildin No. 165. Management Methods in the Risportry Plantation. By A. H. Teske and V. R. Gardner. Pp. 24. (East Lunsin. Micr.). Benchts der Naturforscheiden Geselschaft zu Frendung. Bi. Herausgezeien von Prof. Br. J. L. Wilsen. Achtundzwan "Ster Barl. Erstes Haft. Pp. 238. (Freiburg. Br.).

Bullein of the Anneman Massum Comp. Eigenston. By. C. H. Curtan. Pp. 38-9. (New York C. tv.).

University of Oregon Publication. Geology Series, Vol. 1, No. 2. A. Quantitution. Mineralogical and Chemical Classinaction of Igreous Roses. Swy Edward. Honge. Pp. pp. 4132-200. (Eugene, Oregon). 1.25 dollars. Proceedings of the United States National Museum. Vol. 72, Art. 1: Description of Analysis and a Review of the Geology. Art. v. New Species of Two-Winder Fines of the Family Cyrtinge, with a new Genus from the Pulippines. By. J. M. Adlich. (No. 2705). Pp. 4. Vol. 72. Art. v. New Species of Two-Winder Fines of the Family Cyrtinge, with a new Genus from the Pulippines. By. J. M. Adlich. (No. 2705). Pp. 4. Vol. 72. Art. 21. The Oxidation of Metaona Iron With Cimparative Best primers of the Carolinas. By. Llovd W. Stephenson. (No. 2706). Pp. 2. Art. 21. The Oxidation of Metaona

#### CAIALOGUE

Standard Catalogue, Vol. 1, 1928 edition. Chemistry, including Apparatus for the Teaching of and Research Work in Chemistry, Organic and Forcan c., with Special Sections on Industrial Chemistry, also Assay and Meteorological Apparatus Pp win+1142 (London, Baird and Tatlock (London), Ltd.)

#### Diary of Societies.

#### SATURDAY, DECEMBER 10.

SATURDAY, December 10.

Mathematical Association (at Bridtind College for Women), at 3—F C Boon: A Mathematical Course for Post-Mathiculation Non-Specialists North of Excland Institute of Mining and Mechanical Excineers (Associates and Students' Section) (at Newcasile-upon-Type, at 3.—A M. Biyan: A Contribution to the Solution of the Projem of Underground-Hadlage Accidents, with Special Reference to the Northern Mines Inspection Division—"Orent for turber at a sign — Feeding and Treatment of Anneais Below Ground and Stabling, by W. S. Rider; Remarks on the Mines (Working Facilities and Support) Act, 1923, by J. S. Robinson.

Royal Institution of Geral Britain, at 5—F J. M. Stratton. Recent Developments in Astrophysics (I.)

British Paychological Institute, at 3—Conse cation and Decision as to Proposed Alterations of the Rules of the Society—(Annual General Meeting)—Prof. Mary W. Calkins. Self Psychology.

Mining Institute of Scotland (at Royal Fechical College Glasgow), at 3—Papers open for discussion—Miners. Nystagmus, by Dr. J. S. Haldane and Dr. T. Lister Llewellyn., An Improved Fac. Conveyer, by A. V. Reis; The Transport of Injuried Persons Underground, by D. Davidson.

Payson official Society and Department of Physiology. Redford College.

D. Davidson.

D. Davidson.

Physiological Society (in Department of Physiology, Bedford College), at 4 – J. P. Bouckaert: Factors influencing Muscle Viscosity —W. H. Craib. Electrical Responses from a Strip of Curarised Skeletal Muscle under Various. Conditions —K. E. Harris: Observations upon a Histamine-like Suostance in Skin Extracts —T. Lewis: The Active Relaxation of Capillaries and Venules in the Reflex Flare —H. Florey The Disphragmentic Lymphatics and Absorption from the Peritoneal Cavity. —F. R. Curtis. Differences between the Activities of Adrenaline and Ephedrine — F. C. W. Davies and M. Rabinovich: The Effects of Sublutaneous and Intraperitoneal Injections of Oxygen upon the Oxygen Saturation of Arterial Blood.

#### MONDAY, DECEMBER 12

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5—Dr Vening Meinesz Gravity Survey by Submarine via Panama to Java Royal Society of Medicine (Wai Section), at 5—Wing Comdr. T S Rippon The Dauger Instincts Institution of Automobilis Engineers (Birmingham Branch) (at Queen's Hotel Binningham) at 7.—Di A F Burstall Experiments on Various Gaseous Fuels in a High-Speed Internal Combustion France

Institution of Electrical Engineers (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—Prof E W. Marchant High-Frequency Currents (Kelvin Lecture).

Institution of Electrical Engineers (North-Eastein Centre) (at Atmstrong College, Newcastle-upon-Tyne), at 7—D B Hoseason Squirrel-Cage Induction Motors
Institute of Metals (Scottish Local Section) (at 3) Elmbank Crescent, Glasgow), at 730—Dr. R Hay Age Hardening of Alloys,
Railway Club (25 Tothill Street, S W), at 730—K Brown The Story of a Detelict Line—the Chesteiford and Newmarket Railway Institution of Electrical Engineers (Western Centre) (at Swansea)
Medical Society of London.—Dr E Callender Di. Gordon Holmes, Sir Maurice Craig, and others: Debate on Insomnia

#### TUESDAY, DECEMBER 13.

ROYAL SOCIETY OF MEDICINE (Therapeutics Section), at 5.—Dr H H Dale, Di. G Graham, and others: Discussion on The Action of Synthalin.

Symmetric from the Great Britain, at 5 15 — Sir William H Bragg A Year's Work in X-Ray-Crystal Analysis (IV)
INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30 — H. R. Ricardo and others Detonation in Motor Fuels (Symposium)

INSTITUTION OF CIVIL ENGINEERS, at 6

INSTITUTION OF CIVIL ENGINEERS, at 6
ILLUMINATING ENGINEERING SOCIETY (at E.L M.A. Lighting Service
Burean, 15 Savoy Street, W.C.), at 6—J L. H. Cooper An Investigation of Electric Lighting in the Engineering Industry.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and
Technical Group), at 7.—M. P. Villard. On the Chemical Effects of
Radiations—H. W. Lee. Change of Focus when the Object possesses
Great Depth—P. P. O'Shaughnessy: The Rate of Desilveration of the
Wet Collodion Silver Bath
UNITIMIZED OF ENGINEERS (North-Western Centre) (at

Wet Collodion Silver Bath
INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at
Engineers Club, Manchester), at 7.
INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at
Hotel Metropole, Leeds), at 7 15.—W. McClelland The Applications
of Electricity in Warships
Society of Chewical Industry (South Wales Section) (at Technical
College, Cardiff), at 7.30.—Dr. S. R. Illingworth: Notes on Coal
Research.

Research.

Research.

Research.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7 30.—F. H. Clough. The Stability of Large Power Systems

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.—E. Hatschek: Some Properties of Jellies (Lecture)

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Royal Society of Arts), at 8 16.—Prof. T. P. Nunn: Anthropomorphiem in Science.

ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8 30.—Dr. M. Culpin. A Study of the Minor Psychoses. their Clinical and Industrial Importance.

ILLUMINATING ENGINEERING SOCIETY —J L. H. Cooper: An Investigation of Electric Lighting in the Engineering Industry

INSTITUTION OF MECHANICAL ENGINEERS (SWAINEA BERAICH).—J. Adamson and F. Jones. Reduction of Steel Works Costs by the Use of Waste-Heat Boilers.

Heat Boilers.

### WEDNESDAY, DECEMBER 14.

WEDNESDAY, DECEMBER 14.

SOCIETY OF GLASS TECHNOLOGY (at University College), at 2 40 —J H. Davidson and Miss V Dimbleby: The Analysis of Opal Glasses —Miss V. Dimbleby and Prof. W. E. S Turner: The Durability of Iron Containing Glasses —Dr. S English, H. W Howes, and Piof W. E. S Turner: The Effect of Iron Ovide on the Properties of Glass

ELECTRICAL ASSOCIATION FOR WOMEN (at 35 Newman Street, W), at 3 — H. H. Berty. Colectric System of Heating

ROYAL INSTITUTE of PUBLIC HEALTH, at 4 —Dr. E. W. Hope: The Changed Conditions of Quarantine.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Sir Napier Shaw, R. G. K. Lempfert, and Miss B. E. Austin' International Commission for the Upper Air. Report on the International Days of 1928.—Sir Napier Shaw Geopotential and Height in a Sounding with a Registering Balloon.—L. F. Richardson and R. E. Munday: The Single-layer Problem in the Atmosphere and the Height-integral of Pressure.—

L. F. Richardson, D. Proctor, and R. C. Smith' The Variance of Upper Wind and the Accumulation of Mass.

GEOLOGICAL SOCIETY OF LONDON, at 5 30.—Dr. E. Greenly: The Lower Carboniferous Rocks of the Menaian Region of Carnarvonshire: their Petrology, Succession, and Physiography, with Palæontological Notes by Dr Stanley Smith.

INSTITUTION OF ACTOMOBILE ENGINEERS (Manchester Branch) (at Engineers' Club. Manchester). at 7.—G. J. Rackhem. The Modern

INSTRUCTION OF AUTOMOBILE ENGINEERS (Manchester Branch) (at Engineers' Club, Manchester), at 7.—G J. Rackham: The Modern Motor Bus.

Motor Bus.

Electrical Association for Women (at E.L.M.A. Lighting Service Bureau, 15 Savoy Street, W.C.), at 7—Miss M. G. Reading and others: Discussion on Some Difficulties in dealing with Consumers.

North-East Coast Institution of Engineers and Shipbuilders (Graduate Section) (at Boldec Hail, Newcastle-upon-Tyne), at 7.15—H. Caird: Ship Ventilation.

Glasgow University Alchemists' Club (in Glasgow University), at 7 30.—Dr. R. M. Bronte: Medicine and Crime.

Mersesside Aquarum Society (at 1 Falkland Road, Egremont), at 7.80.—F. Jefferies: The Diseases of Fish and their Diagnosis

Bradford Engineering Society (jointly with Society of Chemical Industry, Society of Dyers and Colourists, Textile Institute, Bradford Textile Society, and Bradford Scientific Society) (at Mechanics' Institute, Bradford), at 7.30.—H. P. Hird: Low Temperature Carbonisation (Lecture).

Institute, Bradford), at 7.30.—H. P. Hird: Low Temperature Carbonisation (Lacture).

ROYAL SOCIETY OF ARTS, at 8.—Major R. G. H. Clements: The Evolution of Modern Road Surfaces

FOLK-LORE SOCIETY (at University College), at 8.—Prof. H. J Fleure.

Race Contacts in Folk-tale; with illustrations from Wales.

LANCASTER ASTRONOMICAL AND SCIENTIFIC ASSOCIATION (at Storey Institute, Lancaster), at 8.—E. W. H. Piper: Wells Cathedral.

Russics Society (at Royal Society), at 8.30.—Sir Bernard Mallet.

Problems for Research arising out of the Population Conference.

No. 3032, Vol. 120] The state of the s

ROYAL SOCIETY OF MEDICINE, at 0.30 —Sn Alexander Houston. The Romance of London's Water Supply

#### THURSDAY, DECEMBER 15

LINNEAN SOCIETY OF LONDON, at 5 -Dr K Munster Strom Recent Advances in Linmology -Dr. T A Stephenson. Species among the Coelenterata

Colenterata
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—
Prof E T Whittaker. The Influence of Gravitation on Electromagnetic
Phenomena (Lecture)
Royal Institution of Great Britain, at 5.15—J. Kewley Petroleum
Natural Gases and their Derivatives (II)
INSTITUTION OF MINING AND MATALLURGY (at Geological Society), at 5.30
INSTITUTION OF ELECTRICAL ENGINEERS, at 0—D B Hoseason SquirielCase Induction Mators.

Care Induction Motors

INSTITUTE OF METALS (Burningham Local Section) (jointly with Birmingham Metallurgical Society and Stafford-shire Iron and Steel Institute) (at Engineers Club, Burningham), at 7—Dr L Aitchison Duralumin

INSTITUTE OF PATFITEES (at Canton Hall), at 8—A Ryner: The Commercialisation of Inventions in this Country.

INSTITUTION OF MECHANICAL ENGINEERS (Birmingham Branch).—Sir William H. Bragg 'Application of X rays to the Study of the Crystalline Structure of Materials (Thomas Hawksley Lecture)

#### FRIDAY. DECEMBER 16

Association of Economic Biologists (at Imperial College of Science), at 230-Di G. H Rodman Insectivorous Plants and How They

at 230—DI G. H. Rodman Insectivorous Plants and How They Live (Lecture).

INSTITUTION OF MECHANICAL ENGINEERS, at 6—L. H. Fry Soma Experimental Results from a Three Cylinder Compound Locomotive Institution of Electrical Engineers (London Students' Section), at 6 15—E. B. Watton Automatic Voltage Regulators

INSTITUTION OF LOCOMOTIVE ENGINEERS (Manchester Section) (at College of Technology, Manchester), at 7—G C. R. Parker and R. C. Bond Short Papers

MINCHESTER LUTERARY AND PHYLOSORIEM. SOCIETY (Chemical Section)

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section),

at 7
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group, Informal Meeting), at 7.-F. C Tilney: The Halation Fallacy
JUNIOR INSTITUTION OF ENGINEERS, at 7.30-P J Haler Hardening and Quenching throughout the Ages
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group, jointly with Liverpool Sec ion) - C. S Garland Oil Pollution of Seas and Harbours, and a Remedy

#### SATURDAY, DECEMBER 17.

North of England Institute of Mining and Mechanical Engineers (Newcastle-upon-Tyne), at 2 30.
ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —F J. M. Stratton: Recent

Developments in Astrophysics (II ).

#### PUBLIC LECTURES.

SATURDAY, DECEMBER 10

HORNIMAN MUSEUM (Forest Hill), at 3 30 -Miss M. A. Murray The Legacy of Egypt

MONDAY, DECEMBER 12.

University College, at 5.15 - H Jenkinson: Seals, Mediaval and Modern

C Crowther Modern Ideas of Pig Feeding

#### TUESDAY, DECEMBER 13.

University of Leeds, at 8. - St. John Ervine: Some Impressions of America

### WEDNESDAY, DECEMBER 14

King's College, at 530.—Prof. R Peers Adult Education.
London School of Economics (at National Telewriter Co., Ltd., 20
Bucklersbury), at 6—Demonstration of the Telewriter
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 (for Workers in the

Building Trades) .- E. Law Hampton Court Palace

#### CONFERENCES.

DECEMBER 13 10 16.

International Conference on Light and Heat in Medicine and Surgery (at Central Hall, Westminster)

Surgery (at Central Hall, Westminster)

Dec 13 and 14 (Section 1).—Light and Heat in Medicine and Surgery:—
Dr F. Nagelschmidt: Ultra-violet and Bioluminescence —Dr. L. G.
Dufestel: Contra-indications for Ultra-violet Therapy —Dr F. Hernaman Johnson. Conjoint Ultra-violet Radiotherapy and Internal
Medicine —Dr J. Saidman The Therapeutic Uses of Infra-red Rays.—
Dr. E. P. Cumberbatch: Recent Advances in Diathermy Treatment —
Dr H S. Banks: The Place of Actinotherapy in Public Health Work

Dec 15 (Section 2).—Scientific Research in Relation to the Practice of
Actinotherapy:—Prof Leonard Hill: The Ultra-violet in Sunlight
and Artificial Sources.—Prof. I. M. Heilbron. Vitamin D and its

Relation to the Irradiation of Foodstiffs —Dr. F. H. Humphirs: Can
the Chemist and Physicist be of Use in Actinotherapy?—(Section 3) —
Recent Advances in Optics.—S. G. Tibbles: Light and Vision.—I.
Spiro. The Treatment of Certain Common Eye Diseases in the Young
by General U.V Irradiation.—Dr. K. R. Smith. Eye Muscle Training.

—Dr. F. W. Edridge-Green: Colour Vision.

#### DECEMBER 15.

JOURNÉES MÉDICALES D'EGYPTE (at Cairo).



## SATURDAY, DECEMBER 17, 1927.

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## Royal Society Publications and Meetings.

In his presidential address to the Royal Society on Nov. 30, Sir Ernest Rutherford referred to certain defects in the publications and in the meetings of the Society It appears that the scientific communications made to the Society are important enough to demand publication, and so numerous that the Proceedings have considerably increased in volume, at any rate in the Physical or 'A' series. The sales, however, though they too have increased, still remain insufficient to cover the cost of printing. Thus the defect of the publications is formulated by the president as a lack of funds, and he appeals for further endowment.

It should be remembered that very many of the Society's publications are sent out partly as gifts, partly in exchange for other publications, and the value of the latter at least should be set against the pecuniary deficit But, making all allowances, we conclude that the Royal Society has no more success with its publications than have many other scientific societies. From numerous quarters the complaint arises that papers cannot be published, that societies cannot find the money, or that editors and authors have to pay from their own pockets. On the other hand, we see some of our societies in an apparently flourishing condition and many scientific journals produced here in a manner that does not suggest lack of public support, while the number of new scientific periodicals that has sprung up in Germany since the War can scarcely be due to an excess of altruism on the part of German publishers. We can see only two possible reasons for this curious contrast. the failures must be due either to a lack of business management or to the simple fact that the goods are not wanted In these days the appreciation of even the most abstract science is so widespread, and the number of scientific workers and institutions so enormously increased, that there certainly ought to be a demand for the publications of the premier scientific society, so long as they are reasonably up to standard. If this be conceded, an inquiry into business methods becomes the natural suggestion.

If, however, the papers presented to the Royal Society do not appeal strongly enough to the outside world when published, still less do they appeal to the fellows when they come up for reading and discussion. The president's remarks on this subject are almost pathetic. He says: "While special lectures and discussions, and some of the ordinary meetings, are in general well attended, there are occasions when important and interesting

papers are read before a very small audience Quite apart from the painful impression left on the presiding officers, the sparse attendance has inevitably a discouraging effect on the reader of the paper, particularly, as is often the case, if he has come from a distance and spent much time and trouble in order to present the subject matter of his paper in an interesting way "

Sir Ernest merely repeats a very old complaint when he speaks of the "sparse attendance" and "discouraging" lack of interest extent this is a natural consequence of the constitution of the Royal Society It differs from the other learned societies of the metropolis in two points · its members represent all branches of science, and each member is a distinguished specialist in his own branch. Now it is generally, if not universally, true that the more a man knows of one subject, the less does he know of other subjects The number of fellows capable of appreciating an advanced paper on any special theme is necessarily a small minority. The reader of a paper to the Zoological or Geological Society may be sure of an audience of fifty or sixty (as a rule the numbers are far more), and the discussions are only checked by want of time At the Royal Society the same reader would get about one-tenth, simply because he has far less than one-tenth the number of that outside visitors would be welcome, one reply is that few besides those who have retired from active work can attend a meeting so early as 4.30 P.M.

In view of the necessary composition of any probable audience, there are two improvements still feasible. First of all, the author should remember that if in any society his audience must ex hypothesi know less about his subject than he does himself, in the Royal Society the general level of knowledge will be far lower. The less knowledge he assumes in his audience the more successful will his exposition be. "I know that I know, but all the same tell me as if I didn't know." Lack of knowledge does not, of course, imply lack of intelligence It is generally the youngest authors that are most difficult to follow, and a little friendly advice from the officers might induce them to condescend to the level of an F.R.S. In a society hke the Royal, even more than in other societies, the audience is less interested in detail than in the general conclusion, and above all the reader should bring out the relation of his bit of work to the broad concepts of the science. If any readers find that they have too little to say in these aspects, they may perhaps withdraw their claims for time and printer's ink

This leads to the subject matter. It is perhaps, mevitable that the meetings, and still more the Proceedings, should have become a convenient platform for the pupils of fellows of the Society who happen to be distinguished professors The work produced is doubtless valuable but is it of such prime importance as to attract a number of busy men of mature age to Burlington House on a winter afternoon? However this may be, there is no doubt that the Society has turned into a publishing body for a limited number of the physical sciences Indeed, Sir Ernest Rutherford seems almost to glory in the fact, much as Sir Charles Sherrington might take pride in the thought that series B' consists so disproportionately of physiological papers The Royal Society may be performing a charitable act in publishing work that has no other outlet, and yet this does not seem to be quite the proper function of a leading, co-ordinating, organising body. Let it publish these contributions if nobody objects, but there is no necessity for them to be read, even at present a considerable proportion of the papers is taken as read

Sir Ernest Rutherford thinks that the meetings would be better if only more fellows would attend. He seems to us to over-estimate the number of those having special knowledge of selected subject matter, and it may be inquired whether this specialisation of the meetings is really on the right The Royal Society is the one place where students in all the sciences can meet, and its gatherings should make the most of this physicist can help the biologist, the chemist can help the geologist. The subjects of discussion should be such as call for this many-sided help and criticism, or they should be of such broad and general nature so as to transcend the limits of specialisation After all, the average fellow of the Royal Society does wish to learn something of the researches of the other fellows; he only asks that they should present their results in a form intelligible to him.

There is far more promise in the president's invitation to fellows to give demonstrations before the meeting. Informal talks on exhibits have successfully brightened the meetings of other societies, and are more likely to loosen the tongues of authorities with a reputation to lose, especially when combined with tea and coffee. Our only feat is that the fellows will succumb to the enhanced attractions of the tea-room and never reach the meeting-room at all.

Anthropology of the Westernmost Orient.

Ritual and Belief in Morocco By Edward Westermarck. In 2 vols Vol 1 Pp xxxii + 608 Vol 2 Pp xvii + 629 (London Macmillan and Co , Ltd , 1926 ) 50s net

PROF WESTERMARCK, by the publication of his first masterpiece in 1891, gained a worldwide reputation as a historian of human marriage and a leading sociologist, a reputation later on increased by his analysis of Moral Ideas," in which he established himself as a psychologist and a philosopher of the first magnitude His merits as a master of inductive method and as a ruthless critic of insidious fallacies, are rivalled only by his power of building sound theories on the bedrock of biology and of our knowledge of human nature fame gained by his theoretical work has ever since eclipsed Westermarck's other equally astonishing achievement as a first-hand student of the savage or barbarous tribes of the Maghrib—the extreme west of the Oriental World Westermarck's great learning somehow suggests the library, and his philosophic detachment and literary charm, a comfortable study in some ancient university closster, and it is difficult to imagine him in the saddle, climbing maccessible mule tracks in the Great Atlas, or as a daring ethnographic explorer of the Rit, braving dangers so real that , at times he had to be declared outside consular ponsibility and the protection of civilised government

No better field-work exists, however, than that of Westermarck in Morocco. It was done with a greater expenditure of care and time than any other specialised anthropological research; it has brought to fruition Westermarck's comprehensive learning and special grasp of sociology: it revealed, his exceptional linguistic talents and his ability to mix with people of other race and culture

Westermarck in the course of more than two decades, between 1898 and 1926, spent altogether the equivalent of seven years among the various Berber and Arab tribes of Morocco. He has investigated native life and culture through the medium of their own language, living among them, frequently forming ties of personal friendship with the hospitable Shereefs and lordly Sheikhs. The present two volumes embody perhaps the most important and attractive results of Westermarck's research. For although his 'Marriage Ceremonies in Morocco' (1914) is as learned and as valuable as the present book, and his numerous monographs are indispensable for the specialist, the strange behefs and rites

of the Berber hillmen and the nomads of the desert will be more interesting to the general reader.

These two volumes, though primarily a model of method and scholarship, read like a novel of Marmaduke Pickthall or the 'Arabian Nights' In fact it is perhaps the best companion and commentary to any oriental classic Take, for example, the jinn, the special race of spiritual beings who constantly play pranks on men and women Any of us who still retain our childish delight in Oriental literature are well acquamted with them, but we have never known their real nature In the present book Westermarck for the first time gives us their genealogy, their natural history, and many wise hints as to how to deal with them origin, their Asiatic and local antecedents, their true sociological nature—contradicting Robertson-Smith's totemic explanation—are given in a special chapter, for Westermarck is always careful to keep theory apart from statement of fact. And then we learn all there is to be known about them from Moroccan folk-lore, the opinions of the Koran, the comments of the learned and the scribe, and above all the stories current among the people This popular belief impresses us with its freshness and imaginative power, with the flavour of the wonderful and miraculous, which prove that the Thousand and One Nights are not yet at an end, unless they be extinguished by the cold light of civilisation recently poured into Westermarck's Morocco by machine gun and aeroplane though these beliefs will undoubtedly soon die, their ghosts will remain in the stories preserved for These stories show us jmn conus in this book sorting with pedlars in the market-place, leading young scribes astray and entering into love intrigues with man or woman—for there are female as well as male junn The spirits become so ubiquitous that we are glad to find in a special chapter exact prophylactic measures against them and remedies for the troubles which they cause.

The long chapter on the evil eye appeals no less to the antiquarian's imagination than to the interest of the sociologist. One of the oldest superstitions of the Mediterranean basin which still survives in the behaviour of civilised man, whether of Latin, Berber or Semitic race, is here described again with a fullness of detail and theoretical might which defies comparison. A wealth of descriptive data, collected at first hand, is given, and then a comparative treatment of the problem, an analysis of the belief, and a number of interesting sidelights on its cultural influences. A description of the imprint of the evil eye upon decorative art,

given with many interesting illustrations, will remain among one of the most illuminating contributions to comparative folk-lore

The anatomy of swearing and cursing will be of great value to all those interested in the subject There is no doubt that a European will feel stricken by the poverty of his own language, more especially, perhaps, the Anglo-Saxon, whose repertoire, since the good days of Shakespeare and the buccaneers, has been gradually depleted by puritanic superstition and mid-Victorian prudery The dilettante will therefore find impressive data in the long lists and full comments given with scientific calm and candour He might be shocked by finding at the outset such a simple expression as "God damn you," somewhat more elaborated in the explicit "God damn your grandfather and the grandfather of your grandfather, and the grandfather of him who will not curse your grandfather," but by the time he arrives at the end of the chapter he will find these expressions pale and lacking in vigour.

Witchcraft and the practices of transference of evil give us a good insight into native belief, with its raw flavour of savagery mingled with certain dramatic reminiscences of medieval Europe. The beliefs and customs referring to animals are narrated, with the repressed but powerful sense of humour so characteristic of Westermarck's style and mind, and make this chapter as amusing as "Esop's Fables", while for the psychology of the relationship between man and beast, important for anthropologists in connexion with totemism, this chapter is of the greatest value. The long and excellent descriptions of the ritual of the dead, the beliefs and practices connected with agriculture, the account of the yearly round, following the solemn festive days of the Mohammedan calendar, can only be mentioned here.

Two subjects have yet to be commented upon as of especial interest to the student of man; one of them is the 'Ar or "transference of conditional curses," a remarkable universal phenomenon first discovered and named by Westermarck. The data given and the interpretation of them illuminate the problem of taboo—the cornerstone of primitive law and primitive religion. Westermarck's comments on the covenant among primitive Semites and his criticism of Robertson Smith will be of value to those interested in the Bible, the Jews, and the learned Scottish historian.

The second subject of outstanding importance is the Moorish doctrine of "holiness" or "blessed virtue," the baraka, which corresponds to the famous mana of the Melanesians, the Iroquian

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orenda, the Siouan wakan, the Algonquian manitu, and the Malagasy hasina This type of religious conception has been made a pivotal point in modern comparative study of religion, especially through the contributions of Dr Marett of Oxford. Westermarck's account of the baraka far surpasses, in accuracy, thoroughness, and sociological depth, the data we possess from any other area, and it is bound to influence future theories of primitive religion What Westermarck has to say on magic and religion in his introductory chapter ought to be read and considered by all the students of the subject. for it is the result not only of much impartial thought but also of direct experience with a people who, while remaining in barbarism as regards some aspects of culture, were able to produce among themselves individuals singularly well able to analyse their own belief and that of their fellow tribesmen.

To the student of Semitic language and culture, to the scholar interested in the traces of the Carthaginian, Roman, and Hellenistic influence in North-West Africa, to the general anthropologist and the sociologist interested in culture at the level of higher barbarism, these two volumes will be an mexhaustible source of information and delight

B. Malinowski.

## The Story of Radio-Communication.

History of Radio Telegraphy and Telephony-Written and Illustrated by G G Blake xix +425. (London Chapman and Hall, Ltd, 1926.) 25s net.

THE time for writing a history of 'wireless' has scarcely come yet, but it is well that somebody should collect data and sift material for this arduous enterprise Mr. Blake has done this diligently and conscientiously, and the result is a compilation, or more properly speaking a thesaurus, from which future historians may glean with confidence.

The development of wireless has shown a steady evolution enlivened by spurts of discovery. The main dates of these spurts—a biologist might call them 'sports'—are approximately the following

1864. Clerk Maxwell predicts ether waves.

1888. Hertz demonstrates ether waves experimentally

1889. Lodge discovers the coherer and the principle of tuning.

1897. Marconi's long-distance radio-telegraphy.

1907. Lee de Forest invents the triode valve.

1915. First trans-Atlantic radiotelephony.

1920. Broadcasting.

These dates form a useful scaffolding for the historian, but it is surprising how much detail has been almost forgotten. Mr. Blake recalls the fact that it was Mahlon Loomis, an American dentist, who signalled from one mountain top to another by means of kites and atmospheric electricity Another significant anticipation was the transmission of spark signals over a distance of 100 feet by Prof. Elihu Thomson in 1875, twelve years before Hertz. Nor is it generally realised that it was von Bezold who discovered that electrical impulses are reflected from the insulated end of a conductor and are capable of producing nodes and antinodes at different points on the wire. This was in 1870, eighteen years before Hertz, and twenty years before Lecher.

The chapter on detectors recalls many forgotten incidents of wireless development. We find a description of positive point electrolytic detectors of Ferrie, Fessenden, Vreeland, Schloemilch, Shoemaker, and Reich, all of which have been superseded by the various crystal detectors of which Dunwoody's carborundum detector was the first. An interesting chapter is devoted to the photophone and allied methods of signalling by short waves of the order of light waves. Here the author gives full credit to that brilliant German experimenter, Ernst Ruhmer, whose name, by the way, he spells Ruhmer, a very prevalent mistake probably due to over-correction.<sup>1</sup>

Dealing with spark generators of high-frequency currents, the author gives an interesting account of the 'airblast' spark gaps of Lowenstein, Massie, Fleming, Richardson, and Shaw, and the rotary disc dischargers of Lodge and Chambers.

The most valuable chapter of all is the one on the thermionic valve. Here the author's prodigious industry comes into full play. The subject is one which he evidently has much at lneart, and he seems to have followed the development of the valve through all its stages, both practically and theoretically, for we owe to him several beautiful models showing the action of the valve.

The feature which will appeal most strongly to those who wish to find their way through the maze of wireless inventions and discoveries is the list

¹ The linguistic principle of over-correction may be stated as follows: The consciousness of a prevalent fault or omission in using a language leads to correction or replacement in places where it is not justified. The most familiar illustration is the unjustinable reappearance of h's' in southern England, but we may also quote the insertion of non-existent accents in French words; and some writers make the mistake of aspirating consonants (for example, bhoy) or modifying vowels ('same' for 'seem') in places where no Irishman would do so The Germans make similar mistakes Having been told that the final d' of hand is soit instead of hard as in German, they also show a tendency to soften the final consonant in such words as 'boot' and 'book.'

of references, which occupies fifty pages The references are to books, periodicals, and patent specifications, and cover about fifty years.

We are accustomed nowadays to a flood of wireless literature liberally sprinkled with illustrations, which are, in effect, advertisements of certain brands of wireless instruments Mr Blake's book is refreshingly different Most of the two hundred or so illustrations have been drawn by himself, and drawn in a manner which will command the respect of the most advanced electrical draughtsmen Many of these drawings have been prepared to illustrate half-forgotten principles. Any of these might suddenly become of importance. So rapid, and even precipitate, has been wireless progress that many valuable ideas are in danger of being swallowed up and engulfed in the thronging crowd of new things. Mr Blake's book has rescued many a pearl from being thrown on the scrap heap.

E. E F D'A.

# The Borderland of Physical Chemistry and Physiology.

Physikalische Chemie der Zelle und der Gewebe Von Prof. Dr Rudolf Hober Sechste, neubearbeitete Auflage Pp xv1+955 (Leipzig Wilhelm Engelmann, 1926) 42 gold marks.

In his exacting task of elucidating the nature of living processes, the physiologist wisely draws on his colleagues in other branches of science for all the help they can give him. With the aid of the organic chemist, for example, he has already learnt how to isolate, analyse, and synthesise such fundamentally important substances as adrenaline and thyroxine. every day he likewise applies the technique and theories of the organic chemist to further his knowledge of that marvellous sequence of co-ordinated chemical reactions which constitutes metabolism

The relations between the physiologist and physical chemist have been, perhaps, of an even more intimate nature. Physiology, seeing that it consists so largely of interchanges of matter and energy between semi-fluid cells and their fluid environments, offers signal opportunities for the application of theories of solution, mass action, surface chemistry, and so forth. So pressing, indeed, have been the needs of the physiologist, that in some cases he has not had the patience to await the necessary developments in pure physical chemistry, but has taken the law, or rather the laws, into his own hands, and laid the foundation stones of such developments himself. One need only

recall that the first precise measurements of osmotic pressure were made, not for chemical but for physiological purposes, by a botanist, Pfeffer: and that in more recent times Sir William Hardy, stimulated alike by the needs of biology and chemistry, has proved himself a pioneer not only in the field of colloidal chemistry, but also in the understanding of a subject which bulks largely m the mind of the physical chemist of to-day, namely, that of molecular orientation at interfaces. At the present time, the harvest reaped by this fruitful liaison appears to be not only maintained but also to be increasing, as is indeed shown by the work of A. V. Hill, Hober, Michaelis, and others. For that reason we cannot but extend a very cordial welcome to the latest edition of the most comprehensive treatise on the subject in existence—Hober's

'Physikalische Chemie der Zelle und der Gewebe" Hober's book consists of two main divisions. Of these, Part I deals with such portions of "the physical chemistry of homogeneous and heterogeneous systems" as are considered applicable to physiology, and hence includes chapters on osmotic pressure and diffusion, the ionic theory of solutions, measurement of hydrogen ion concentrations, surface phenomena, colloid chemistry and enzymes Unlike some writers, Hober shows himself equally at home both in the theoretical and practical -application of these subjects. The theoretical treatment is almost invariably sound, if not always quite up-to-date, and is so continuously and ingeniously interwoven with physiological applications that even the heart of the most biologically inclined reader must at times be softened. A physiologist should not fail to be more interested, for example, in the nature of osmotic membranes, when he learns so vividly from Chap. i that it was from the structure of the single plant cell that Pfeffer drew a leading hint as how to construct a really semi-permeable membrane. No less stimulating are the detailed discussions of the ionic theory of salt solubility (especially in connexion with uric acid and the solubility of its salts in the body fluids), and the comparison of suspensoid and hydrophile colloids, together with the application of this knowledge to the colloidal behaviour of living cells. Chap. vi., on enzymes, is perhaps the weakest in the book, but this can be readily excused by the German reader, who has access to the massive text-books of Euler and Oppenheimer.

It is to be hoped, however, that in future editions more attention will be given to the theory of ionic activity and its physiological successes, and that the fundamental work of Langmuir and Adam on

molecular orientation in thin films will receive more than the passing notice accorded in Chap iv. of the present edition A statement and appraisement of the divergent views on protein ionisation held by the respective schools of Pauli; Sørensen, and Loeb would also be welcome

Part 2 deals directly with the physical chemistry of cells and tissues and contains chapters on the body fluids, the osmotic properties and permeability of cells and tissues, narcotics, the physiological action of single electrolytes and ion combinations, electrical processes at physiological interfaces, absorption and secretion, and physical chemistry of matter and energy exchanges Here the author reaches his zenith, both as regards his powers of exposition and his usefulness to the reader. Each topic is summarised in a manner which is at once comprehensive, lucid, and well arranged, and though the discussions may be inferior in stimulating power to those of Bayliss in his "Principles of General Physiology," yet they contain much of great value in the way of criticism and suggestiveness.

It is difficult to select for special commendation from much that is good: but we venture to think that the treatment of cell permeability, Hofmeister ion series, antagonistic and co-operative action of different cations, and the recent work on kidney function will be found to be of the greatest value to the student, both on account of the intrinsic merits of these summaries and of their maccessibility elsewhere. In each case the reader is left with the impression that he has now got a really first-hand grip of the topic in question—possibly a dangerous delusion, but one of great help to him if he has to lecture on the subject

The last chapter, on the physical chemistry of matter and energy exchange, is in some ways the most fascinating, but is certainly the least complete. In further editions it is to be hoped that the sections on the temperature coefficients of vital processes and the action of light in biology may be expanded so as to include the recent interesting work on these subjects. But the most urgent need, in the opinion of the reviewer, is that some industrious and competent linguist should prepare an English translation of "Hober" and so render him more easy of approach by that growing group of scientific workers who are attracted to the borderland of physical chemistry and biology.

In conclusion it should be noted that Hober\* takes up no philosophical position in regard to the ultimate nature of life: he does not lay down that all living processes are reducible to the same

conceptual shorthand as physics and chemistry, nor does he deny it. He is content to indicate the great achievements already to the credit of this powerful shorthand, and to leave his readers in a mood of optimistic agnosticism as to the future. If ever there comes a limit to the extent to which physico-chemical interpretations of life can be pushed, that limit will surely be very much nearer to the ultimate goal of biology than anything that has yet been reached. Such is the impression derived from reading Hober's book, such, indeed, is the policy which directs and stimulates the majority of modern physiological research.

F. J. W R

## Rheumatism and Gout.

Aspects of Rheumatism and Gout . their Pathogeny, Prevention and Control By Llewellyn Jones Llewellyn Pp xiii+295. (London · William Heinemann (Medical Books), Ltd , 1927) 10s net.

In "Aspects of Rheumatism and Gout," Dr. Llewellyn, who has written much on these spa diseases, has collected the material of a number of his addresses and essays, many of them previously published, dealing with their pathogeny, prevention, and control, into an eminently readable and suggestive whole. In the foreword the plan of the work is outlined, and this is followed by a disquisition on diathesis, a subject which Sir Archibald Garrod has, since this volume appeared, treated in the Huxley lecture at Charing Cross Hospital; the rise, echipse, and revival of the diathetic conception are sketched, and diathesis is regarded as a synonym for chemical individuality.

The diathesis of acute rheumatism or rheumatic fever is characterised by an inborn tendency to a want of the normal endocrine-autonomic balance which is manifested by instability of the functions of the skin and is essentially an inherent deficiency in the power of organic regulation. Similarly, in rheumatoid or atrophic arthritis, in osteo-arthritis and gout, the author finds evidence of this endocrineautonomic imbalance, and further concludes that infections, if and when responsible for arthritis, act not directly but indirectly—the intermediary mechanism being instability or defect of the neuroendocrine system. As bearing on this view, the geographical correspondence in the incidence of goitre and of acute rheumatism and cardiac disease, which is so prominent in Bristol, is brought out. Later on, the resemblance of acute rheumatism to serum sickness, or the symptoms following injec-

tion of horse serum, is pointed out, and the view that infection causes the instability of the neuro-endocrine system, which is the exciting cause of the joint symptoms, is again suggested. In considering the prevention of acute rheumatism and heart disease, the importance of supervision in the pre-rheumatic phase is emphasised.

The relation of oral sepsis and arthritis, which has been so much in the limelight, is dealt with in considerable detail, and gout, on which the author wrote a book some seven years ago (1920), is described as a hereditary condition of hypersensitiveness to protems and analogous to asthma, the remarkable food idiosyncrasies of the gouty being brought forward to enforce the argument. It would thus appear that the gout-producing factor in alcoholic liquors is not the alcohol, but some protein such as hordem in beer and yeast cells in wine. A chapter is devoted to the common ailment lumbago, or pain in the back, and the difficulties in diagnosis are dealt with in chapters on the pitfalls in connexion with sciatica and arthritis. In conclusion, it should be said that the author's method of presenting his subject matter and style of writing add an attraction to the interest of these common diseases.

## Our Bookshelf.

Colloids: a Textbook. By Prof. H. R. Kruyt. Translated from the Manuscript by Prof. H. S. van Klooster. Pp. xi+262. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 17s 6d. net.

The author says in his preface that his purpose has been to write a text-book or, in other words, "to offer a main line of orientation to students who wish to become acquainted with the general trend of Colloid Chemistry or who desire to undertake research in this particular branch of Chemistry." The work may certainly be said to accomplish this purpose and to have solved the fundamental problem of text-book writing—that of selection from an enormous mass of material—with complete success.

A general introduction begins with a brief description of colloidal systems, gives in less than forty pages a clear and concise account of boundary phenomena, and concludes with a description of the electrical conditions at interfaces. The second part, the largest of the book, is devoted to suspensoid sols; a number of important generalisations from the vast mass of data on charge, flocculation, etc., are developed very clearly. The third part, dealing with emulsoid sols, departs more markedly than the rest of the work from traditional lines. The author takes as a type of this class the agar sol, which is certainly to be preferred to gelatin, and shows that its stability is a function of two factors, hydration

and electric charge, if either of these separately is reduced, the sol alters its character but remains The author is inclined to deal somewhat lightly with the anomalous viscosity of emulsoids, which have occupied both Freundlich's and Ostwald's laboratories considerably during recent years, but perhaps this is one of the simplifications made in the interests of the beginner, it is, however, certainly incorrect to say that a linear relationship between viscosity and concentration holds in agar, gum arabic, or starch sols, except at the very low concentrations and comparatively high temperatures at which the author and his students have chiefly examined them. In sols like those of indiarubber or cellulose nitrate it does not hold even at concentrations between 0 1 and 0 5 per cent. The remainder of Part 3 is devoted to protein sols, osmotic phenomena, and gels; though brief, these chapters are extremely lucid and instructive, and the reviewer has been struck particularly by the presentation and critical examination of Loeb's views A short fourth part deals briefly with special cases of interest, such as soaps and emulsions.

The translation is idiomatic and nowhere leaves the reader in doubt about the author's meaning. The book is excellently printed and illustrated.

E H

Eruptive Rocks: their Genesis, Composition, Classification, and their Relation to Ore-Deposits; with a Chapter on Meteorites. By Prof. S. J. Shand. Pp. xx+360. (London · Thomas Murby and Co.; New York: D. Van Nostrand Co., 1927) 20s. net.

Prof. Shand's interesting and original book is, as he says in the preface, the outcome of three msistent wishes: first, to clean up the "jungle of rock names". second, to make the results and conclusions of petrology intelligible to "matter-of-fact people like physicists and chemists" (we did not know before that petrologists were less matter-offact than physicists and chemists); and third, to "bring theory and practice together to save petrology from the reproach of being an academic study of little use in life" Prof. Shand has produced an admirably stimulating work, but we are not sure he has achieved the above aims. The classification of igneous rocks he has devised is based upon a sound plan, just as Esperanto is, but it may fail for the same reason that artificial languages fail, because it is too clean-cut and logical, and has not grown up with the science. He does not clean up the jungle of rock names; on the contrary, he adds to the undergrowth a number of new terms with the aid of the overworked prefixes and suffixes, per-, sub-, meta-, -oid, and the

The most successful part of the book, indeed, is not the classification, but the exposition of physico-chemical principles as applied to the crystallisation of natural magmas. This occupies the first five chapters, entitled "Eruptive or Igneous Rocks," "The Fixed Constituents of Igneous Rocks," "The Fugitive Constituents of Magmas," "The Magma and its Walls," and "The Freezing of

the Magma "Chaps. v1 to xiv. discuss classification m general, Prof Shand's own system and nomenclature, and descriptions of igneous rocks in relation to this system. The book concludes with chapters on meteorites and eruptive ore deposits

In describing the rocks assigned to various divisions of his classification, Prof. Shand has made a valuable survey of recent igneous petrography. The description of each main group is appropriately prefaced with a section on its geology, a feature often neglected in petrographical treatises. This book forms a very notable addition to petrological literature.

Second Experimental Report to the Atmospheric Corrosion Research Committee (British Non-Ferrous Metals Research Association). a Discussion held by the Faraday Society, 30th March 1027 By Dr. W. H J Vernon. Pp ii+113-204 (London: The Faraday Society, 1927.) 8s 6d. net.

It is quite impossible in a short survey to give any real indication of the amount of valuable information contained in this report. Systematic investigations on the indoor atmospheric corrosion of copper, brass, aluminium, lead, and zinc are recorded, whilst in the case of copper, brass, and zinc, outdoor exposure has also been examined.

Weight increment—time curves are given, and the value of the protective coating formed in some cases is revealed. The effect of oxide films on brass upon its subsequent corrosion in a polluted atmosphere is indicated. Exposure of zinc over a period of three years shows that, in an indoor unsaturated atmosphere, a straight line relationship holds except for the first twenty-four hours.

An outstanding feature of the report is the portion giving detailed analyses of the outdoor corrosion products, the proportions of sulphate, sulphide, carbonate, and oxides being determined. The corrosion product is shown to be less easily eroded in some cases than others. The deposit on copper is the most tenacious and that on zinc the least. In the latter case some 90 per cent. of the deposit is removed by weathering during outdoor exposure.

The influence of alloying impurities in the metals is not very appreciable during indoor exposure, but in certain cases it is very pronounced during outdoor exposure; thus arsenical copper and, to a lesser extent, copper containing nickel, is more resistant to attack than H.C. copper.

Some laboratory experiments upon the atmospheric corrosion of iron are included in the report. Solid suspended impurities in the atmosphere are shown to be responsible for the corrosion of iron in an atmosphere of low relative humidity. Screening the metal by preventing the access of such solid particles inhibits the corrosion. The influence of rust upon the subsequent corrosion of iron in an unsaturated atmosphere is also demonstrated.

In conclusion, the report embodies the results of a research covering a wide range and carried out with a patience and accuracy which can only be described as classical.

W. S. Patterson.

The Mollier Steam Tables and Diagrams extended to the Critical Pressure By Prof Dr Richard Mollier English edition adapted and amplified from the third German edition by Dr H. Moss Pp. xvi+53 (London Sir Isaac Pitman and Sons, Ltd, 1927) 7s 6d. net

RESEARCH is being conducted in order to obtain accurate knowledge of the physical properties of steam in the regions of high pressure and high superheat, but meantime the rapid development of the use of steam at high pressures and temperatures has accentuated the need for this information. To meet this temporary want, Dr. Molher has extended his tables of 1906, modifying the characteristic equation adopted in the calculations, in order to obtain results which agree consistently with all available data.

The form of equation, that recommended by Prof. Callender, has been retained, but an additional term has been found a necessary refinement at pressures above 30 atmospheres The method of testing this modified equation for reliability is briefly described. It is considered satisfactory for all conditions except for steam in the neighbourhood of saturation over a small range above 150 atmospheres, and the values in this range are obtained by reasonable extrapolation. The upper limits of the tables are the critical pressure and 500° C They are in a convenient form with notes on their practical application A table of coefficients intended to facilitate calculation and two large scale H  $\Phi$  charts are also included. Up to about 30 atmospheres, the values agree closely with previously published results, but in the higher pressure regions the differences are considerable and clearly justify the investigation. Although the book is only intended to have an ephemeral utility, it is a valuable contribution and should be highly appreciated by those interested in high L. M. D. temperature steam.

Les plateaux du Jura central : étude morphogénique.
Par Dr. Georges Chabot. (Publications de la Faculté des Lettres de l'Université de Strasbourg, Fascicule 41) Pp. 350 + 4 planches. (Paris : Société d'Édition Les Belles Lettres; London: Oxford University Press, 1927.) 12s. 6d. net.

The plateaux of the Central Jura are believed to be dislocated fragments of a Tertiary peneplain which have been caught up between the folded ranges. The author correlates this peneplain with that of the Swabian and Franconian Jura, and concludes that the plateaux are "relics of the tabular Jura within the folded Jura." His demonstration would have been more easily followed if it had been accompanied by more adequate maps and sections.

Some interesting chapters deal with the karst phenomena of the plateaux which are compared with the classic region of Illyria. The differences due to local climatic conditions, composition of the rocks, and geological history are clearly and convincingly discussed. The rainfall of the Jura is such as to encourage vegetable growth and continuous chemical action, with the consequent

greater accumulation of residual soil. The folded limestones are thin and alternate with impermeable beds: hence there is considerable run-off as well as constant infiltration. Changing climatic conditions in northern Europe have in the past sometimes promoted, sometimes retarded the characteristic processes of erosion. All these things impart to the karst of the Jura a somewhat hybrid character which is reflected in the peculiarities of the dry valleys, lapiés, dolines, and closed basins of the plateaux. This section of the book is worthy of the closest study.

Magnolias. By J. G. Millais Pp. viii + 251 + 34 plates (London Longmans, Green and Co., Ltd., 1927) 32s. net.

This book, which is well printed and handsomely illustrated, is a handbook to the cultivation of magnolias. The author is an enthusiast, with a great love and knowledge of gardening, and he pleads "for a big move in the planting of Magnolias throughout our islands so as to make England in April as lovely as Japan in cherry time." About forty species of Magnolia are known in the wild state, some deciduous, others evergreen, and all remarkable for their large and beautiful flowers Not all are hardy, but in Sussex at least twenty species grow in the open air. One of these flowers in March, another in October, and other species in the months between.

The duration of the flowering season is remarkable, and Mr. Millais urges that "Magnolias should be planted freely, since no other genus but Rhododendron will give so long a succession of beautiful flowers, without cultivation, expense, or effort on our part."

The greater part of the text is devoted to an elaborate account of all the species and hybrids, giving in each case a clear botanical description, with notes on cultivation and on remarkable specimens in well-known gardens. A key to the genus by Mr Dendy, of Kew, and a special chapter on the magnolias of Yunnan in China by the intrepid explorer, G. Forrest, add to the interest of the book. Another useful chapter gives an alphabetical list of the names and synonyms that have been applied to the species and hybrids.

How a Tree Grows. By Sir Wılliam Somerville.Pp. iv + 212. (London: Oxford University Press, 1927) 10s. net.

This is an elementary treatise on forest botany, based on lectures given to students of forestry at Oxford. It is written in an easy style, and may be perused with pleasure by working foresters, gardeners, landowners, and others interested in growing trees and in the production and sale of timber. The book is well illustrated with more than a hundred diagrams and figures. Many subjects besides that indicated by the title are briefly but clearly dealt with, such as buds, leaves, stipules, seeds, seedlings, fall of the leaf, mycorrhiza, ascent and descent of sap, etc. Most attention is paid, however, to the structure and properties of wood and to the identification of timbers. A good index is provided.

## Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

#### A Contribution to the Piltdown Problem.

SINCE the discovery of the fragments of the Piltdown skull in 1912, there has been considerable difference of opinion with regard to the manner in which the skull should be reconstructed, and as a necessary consequence of this, with regard to the extent of its cranial capacity.

cranial capacity.

Estimates of this have ranged from Smith Woodward's original figure of 1070 c c. (see Nature, vol 92, p. 197; 1913) to his latest estimate of about 1300 c.c. a figure which is approved of by Elliot Smith (see Nature, vol. 109, p. 726, 1922). Keith, on the other hand, at one time estimated its capacity at just above 1500 c c, by measuring the amount of water displaced by the endocranial cast taken from one of

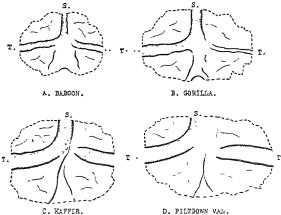


Fig. 1—The stippled areas in the above drawings represent the arrangement and proportions of the venous sinus grooves (transverse sulci) on the internal aspect of the occipital bones of the skulls of: A A baboon with a cranial capacity of 188 c c, B. A gorilla with a cranial capacity of 527 c c; C A Kaffir with a cranial capacity of 1880 c.c; and D. Piltdown man with a cranial capacity of 1415 c.c, estimated from the width of the transverse sulci (T).

his reconstructions (NATURE, vol. 92, p. 197; 1913), but his most recent view, derived from an application of Lee's formula to one of his reconstructions, appears to be that the cranial capacity is about 1400 c.c. ("The Antiquity of Man," by Sir Arthur Keth, vol. 2, 1925). All these estimations were determined from different types of reconstruction, the accuracy of which is disputed, and so far there has not seemed to be any other way of arriving at an estimate of the cranial capacity, and in this way helping to decide whether the higher or the lower estimates are more likely to be correct.

On examining the endocranial aspect of Mr. Barlow's casts of the Piltdown bones, one is struck by the large size and clearness of outline of the grooves for the middle meningeal vessels on the parietal fragments, and of the transverse sulci, that is to say, the grooves for the transverse venous blood sinuses on the occipital fragment. Now the large size of these grooves and of their corresponding blood-vessels does not appear to have been sufficiently emphasised as an indication of the size of the brain-case, for they seem in themselves to suggest a moderately large brain cavity.

That the size of the transverse sulci is correlated with the capacity of the cianium in a definite manner is clear from Fig. 1, masmuch as these sulci are much narrower in a baboon than in a gorilla, and narrower in a gorilla than in man. This is what one would expect, seeing that these sulci lodge the veins, which convey practically all the venous blood returning from the brain. Larger channels are therefore needed for the larger amount of blood returning from larger brains.

A number of observations have therefore been taken on a small group of human skulls to test the degree of correlation between the width of the sulci and the cranial capacity, with the view of arriving at a means of determining the cranial capacity from the width of the sulci.

Cramal capacity	Average width of right and left sulci	Cranial capacity
1300 c.c.	$16~80~\mathrm{mm}$	1370 с с.
1436	17 26	1360
1320	$17 \ 33$	1270
1130	17 80	1406
1615	18 10	1445
1410	18 20	1380
1250	18 30	1450
1280	18 35	1385
1290	18 45	1315
1270	19 40	1420
1450	19.48	1285
1170	19.50	1550
1380	$19\ 52$	1315
1350	19.75	1475
1320	$20 \ 70$	1580
1266	21.00	1665
	capacity 1300 c.c. 1436 1320 1130 1615 1410 1250 1280 1290 1270 1450 1170 1380 1350 1320	capacity right and leit suici 1300 c.c. 16 80 mm 1436 17 26 1320 17 33 1130 17 80 1615 18 10 1410 18 20 1250 18 30 1280 18 35 1290 18 45 1270 19 40 1450 19 48 1170 19 50 1380 19 52 1350 19 75 1320 20 70

The coefficient of correlation between these two variables, in the thirty-two skulls measured, is 0 475, which is definitely significant. The regression formula for the calculation of the cranial capacity in terms of the width has been found to be as follows:

Cramal capacity =  $27.98 \times \text{width} + 894.2$ 

In connexion with this equation there is a probable error of  $\pm 69~0$ 

The average width of the two transverse sulci of the Piltdown occipital bone added together is 18 6 mm. The cramal capacity is therefore estimated from the above formula to be 1415 c.c., or to he somewhere between a lower limit of 1346 c.c. and an upper limit of 1484. This makes the Piltdown skull mesocephalic, and supports those who have arrived at this conclusion by other methods.

Mr. S. Cohen and Mr. P. R. v d. R. Copeman kindly assisted me in taking the measurements and in making the calculations.

M. R. DRENNAN.

Anatomy Department, University of Cape Town.

# γ-ray Emission and the Law of Radioactive Transformation.

Some time ago I described a method (*Phil. Mag.*, vi. 47, 23; 1924) of determining the period of transformation of RaC', which consisted essentially in comparing the transformation constant  $\lambda$  with the velocity v of the recoil-atoms from RaC. The apparatus is shown in Fig. 1a: the active source, which consists of RaC deposited on nickel, is placed on the cone in the lower end of the apparatus. A beam of recoil atoms is limited by the screens S; midway between the screens a number of slits is provided through which the  $\alpha$ -particles from the recoil atoms

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are observed. If the transformation of RaC' takes place according to the law

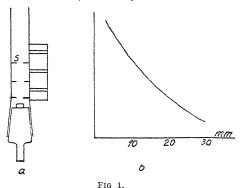
$$N_t = N_0 e^{-\lambda t}$$
, . . .

where t=0 represents the moment at which the  $\beta$ particle is sent out, it is easily shown that the number of a-particles as a function of the distance x from the active source to the slit will be represented by

$$n = n_0 e^{-\frac{\lambda}{v}x}. (2)$$

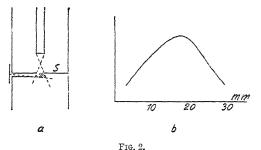
The experiments showed that the number of aparticles decreased approximately exponentially with increasing distance from the source (Fig. 1b), the value obtained for  $\lambda : v$  being about 1.

Later on, Barton (Phil. Mag., vii. 2, 1273; 1926)



repeated the experiment with an apparatus somewhat different in construction and obtained a similar value for  $\lambda : v$ .

In the course of a series of experiments, the object of which was to obtain a determination of v by measuring the stopping power of gases for the recoil atoms, the apparatus shown in Fig. 2a was used among others. The active source is again RaC, deposited on the flat end of a nickel rod 4 mm. in diameter; by means of a



screen S with a circular hole 4 mm. in diameter a beam of recoil atoms is defined — The  $\alpha$ -particles emitted by the recoil atoms are observed through a flat tube  $2\times 10$  mm. in cross-section, which is placed immediately below the screen The number of a-particles observed will be proportional to the number of recoil atoms transformed in the hatched space. By means of a screw arrangement, not shown in the figure, the distance between source and screen could be varied.

The result of an experiment is shown on Fig. 2b, where the number of  $\alpha$ -particles is plotted as a function of the distance between source and screen; a correction has been applied for change in the solid angle covered by the beam of recoil atoms when the source is moved. It is seen that the number of  $\alpha$ -particles with increasing distance rises from zero to a maximum value, from where it again decreases.

By a comparison of the curves in Fig. 1b and Fig. 2b

a striking disagreement is found; obviously in one or both of the corresponding apparatus a source of error must be present which has hitherto been overlooked.

The origin of this difference in behaviour of the phenomenon may be briefly summarised as follows From the work of Knudsen and Langmuir it is known that when atoms of mercury collide with a glass surface they will in general be reflected by an elastic collision, but no condensation occurs when the temperature is above a certain critical value. The collisions between the recoil atoms and the metal walls in the apparatus in Fig. 1a may be expected to behave in a similar manner. When a solid obstacle is placed in the path of the recoil atoms, an accumulation of recoil atoms will This will especially be the case in the space between the first and the second screen in the apparatus Fig. 1a, which will act as a trap for the recoil atoms. When a recoil atom has suffered a collision with one of the walls, the chance for getting out of the space in question without being transformed will be relatively small. It is clear that the number of α-particles emerging from the first slit may be increased several times in this way. For the slits at longer distances from the source a similar effect will be present, but not to the same degree.

The conclusion here arrived at could be verified by placing screens in the path of the recoil atoms in the apparatus Fig 2a; when the distance source-screen was 5 to  $10~\mathrm{mm}$  , the number of recoil atoms could be increased from 2 to 5 times in this way; at longer distances the increase was relatively smaller. From these considerations we may conclude that the decay curve for RaC' has the shape shown in Fig. 2b, and that the apparently exponential decay shown in Fig. 1b has its origin in the source of error outlined above. In the apparatus used by Barton this source of error is not present. The reason that Barton observed a steady decrease in the number of aparticles with increasing distance, seems to be that the regions, which in his apparatus corresponded to the hatched part in Fig. 2a, were broader and at

longer distances from the source.

At first sight the curve in Fig. 2b might be taken to indicate a deviation from the general law of radioactive transformation, the transformation constant  $\lambda$  depending upon the time. A closer consideration shows, however, that a more reasonable explanation, in which the transformation law is conserved, can be obtained by taking into consideration the time required for the emission of the γ-rays It is known that a nuclear electron is sent out from RaC and an a-particle from RaC'. According to Ellis and Meitner, the emission of the  $\gamma$ -rays must be placed between these two, such that the following picture is obtained:



At the time t=0 the  $\beta$ -particle is sent out and the movement of the recoil atom started. The  $\alpha$ -activity of the recoil atom will now vary in the same way with time as if the  $\gamma$ - and  $\alpha$ -rays were sent out from two consecutive radioactive substances When both the γ- and the α-transformation are assumed to take place according to an exponential law (1), and the constants  $\lambda_{\gamma}$  and  $\lambda_{\alpha}$  are adjusted in a suitable way, the curve in Fig. 2b for the  $\alpha$ -activity will result. From the shape of the curve it appears that  $\lambda_{\gamma}$  and  $\lambda_{\alpha}$  must be of the same order of magnitude. By putting  $\lambda_{\gamma}$  equal to  $\lambda_{\alpha}$  and assuming for v, the velocity of the recoil atoms, a value of  $2 \times 10^5$  cm. per sec.,  $\lambda_{\gamma}$  is found equal to 10<sup>5</sup> sec.-1.

This can only be regarded as a rough approximation, since the recoil  $h\nu/c$  due to the emission of the  $\gamma$ -rays has been disregarded. As a result of this, neither the solid angle covered by the beam of recoil atoms nor the time can be simply determined from the distance source-screen.

Experiments are in progress to test the following

two points.

(1) In the case of ThC',  $\lambda_a$  from the Geiger-Nuttall formula may be expected to be very large — Provided  $\lambda_{\gamma}$  is of the same order of magnitude as the velocity of the recoil atoms from ThC, we should expect to find an exponential decay of the a-activity of ThC' with time.

(2) When a preparation of RaC deposited on nickel

(2) When a preparation of RaC deposited on nickel is placed in a vacuum, part of the  $\gamma$ -radiation should originate from the space surrounding the source; by a suitable screening it should be possible to detect a variation with the pressure in the apparatus of the ionisation due to the  $\gamma$ -rays

I desire to express my thanks to Prof. Bohr for the interest he has taken in the work.

J. C. JACOBSEN

Institute for Theoretical Physics University, Copenhagen, Oct. 14.

#### The 'Green Flash.'

REFERRING to Sir Oliver Lodge's conviction that the green flash at sunset is mainly physiological (NATURE, Dec. 3, p. 807), I would point out that this does not explain the appearance at sunrise. green flash has been seen at sunrise by numerous observers; I have myself seen it repeatedly. As seen through field glasses the green flash at sunset has no appearance of being physiological; the two ends of the last visible segment of the sun take on the green hue first, and this spreads rapidly over the whole segment as it grows smaller, until the last visible part of the sun becomes a vivid blue green. This appearance as seen through field glasses has been described more than once. The green flash is only seen when the sun sets behind a distant horizon, whether this be sea, land, or cloud, as would be expected if the flash were due to refraction. If the cause were physiological the flash should be seen when the sun sets behind a horizon close at hand, but so far as I know this is not the case.

With regard to Sir Ohver Lodge's observation of the appearance of a momentary greenness when he switches off a bright light, I have tried a similar experiment (1) with the naked eye, when the first after-image seemed to me to be golden; (2) looking through a yellow, Wratton G, filter, when the first after-image was a deeper gold; and (3) through a deep red, Wratton A, filter, when the first after-image was a very deep red. Some seconds later, when its intensity began to fade, the after-image became a dirty green, and this lasted for a considerable time. Probably different observers react differently, for I notice that my two eyes react in a slightly different manner. It would be interesting to know whether the greenish appearance mentioned by Sir Oliver Lodge has any of the vividness and distinctness of any of the appearances of the green flash that he may have seen.

The green flash at sunrise and sunset lasts a very short time. I should estimate it as half a second at most as seen with the naked eye; it does not fade away gradually as would an after-image, but 'goes out' suddenly at sunset, and at sunrise it changes as suddenly to the yellow of the sun. The appearance at sunrise seems to me definitely to rule out the physiological explanation.

The literature of the green flash is very voluminous, and extends into fiction, but the whole subject was

dealt with by Dr A A Rambaut in the Meteorological Magazine, vol. 41, pp. 21 and 41. After reading these articles, and after having myself seen the green flash many times both at sunrise and at sunset, I can feel no sort of doubt that the explanation is physical and not physiological The explanation as a refraction phenomenon is so simple, and fits the facts so well, that it is curious that there should be such a reluctance to accept it.

C. J. P CAVE.

Stoner Hill, Petersfield, Hants, Dec. 3.

MUCH confusion has beset this subject, because two entirely different things are unfortunately covered by the phrase 'green flash' If separate names had from the first been given to the two things, each would have been treated apart from the other and a great amount of controversy avoided. A greenish light appears as a physiological effect on ceasing to look at the red disc of the setting sun, as Sir Oliver Lodge points out in NATURE of Dec. 3. But there is also a purely physical phenomenon of sunset which is seen at the instant when the last portion of the sun's disc disappears on a sharp horizon During the years when I was much at sea I used to watch every clear sunset, and rarely failed to observe this phenomenon though it was sometimes incomplete It appeared at its best on half-a-dozen occasions when the thinnest segment of the sun's disc was still above the horizon, but with its light so much reduced that it could be looked at easily through a field-glass. However red the sun may have been when fully visible, the tiny shaving of a flat are had become distinctly yellow, and as it was disappearing, the ends turned greenish and seemed to shrink towards the centre, at which the last light visible seemed to be intensified to a clear green point, which changed into blue and vanished in violet in a fraction of a second too short to estimate

During the visit of the British Association to South Africa in 1905, I had many arguments on the subject with sceptical fellow-members, some of whom denied the existence of a green ray, and others explained it as an optical illusion or an effect of fatigue of the retma. The sturdiest doubter was Dr. A. A. Rambaut, the Radcliffe Observer at Oxford, but at last he saw the light from the deck of the Durham Castle as the sun was setting behind Cape Guardafui. A few days later, he, along with Sir Henry Miers and others, caught the first rays of the rising sun and found the colours change in the reverse order from blue or green to yellow. Dr. Rambaut went into the matter fully in a paper, "The Green Flash on the Horizon," published in Symon's Meteorological Magazine for March and April 1906 (vol. 41, pp. 21-23, 41-45). His explanation was that the images of the sum formed by light of definition. of the sun formed by light of different wave-length are not exactly superimposed, and that as the last of the disc passes below the horizon the red image disappears before the yellow, the yellow before the green, and the green and blue images respectively go before the violet image fades. The duration of this change was worked out for various dates and different latitudes, and the conclusions arrived at in this paper have not been controverted so far as I know.

HUGH ROBERT MILL.

Dec. 3.

The physiological theory of the green flash, resuscitated by Sir Oliver Lodge, is not now held by any competent observer who has made a careful study of the phenomenon. The late Mr. Whitmell was, I

believe, the first to arrive at the correct and simple explanation, and he was the first to describe the red flash. His observations are. I believe, recorded in back numbers of NATURE, and in other journals

I have made very numerous observations of the green flash, at sea and on land, and have confirmed

Mr Whitmell's conclusions

If the sun is observed in an achromatic telescope when near the horizon, a green fringe is seen round the upper limb, and a red fringe round the lower limb, due of course to atmospheric dispersion. This green upper segment remains visible for about a second or perhaps two after the sun has set, and it sometimes turns a beautiful violet at the last instant if the atmosphere is clear enough to transmit violet light. The green may be seen with a telescope or binoculars at any sunset or sunrise, in clear air and with a low horizon. It is conspicuous to unaided vision only under certain conditions at sea, when mirage effects enhance its brilliancy (Nature, vol 111, p. 13).

The red fringe may also be seen when the lower limb emerges from the sharp boundary of a dense cloud near the horizon, but the necessary conditions

for seeing this 'red flash' are rare.

J. Evershed.

Highbroom, Ewhurst, Guildford, Dec 3.

This summer, six of us were watching the sun set behind the hills of Jura in a sky absolutely free from cloud and haze. We stood on a moderately high hill, and the sea, four miles broad, lay between us and Jura. Four had not even heard of 'the green ray' I, who had seen the ray on other occasions, suggested that five of us should turn our backs to the sun and close our eyes until the sixth should signal that the upper edge of the sun was disappearing. On his signal we turned, and each saw for an appreciable time a thread of bright green light lining the silhouette of the island at the point where the sun was last seen. In the case of the five, at any rate, this could not have been a subjective after-image.

WILLIAM SEMPLE.

Mile Ash, Dumfries.

## Chinese Alchemy.

COMMUNICATIONS upon the subject of Chinese alchemy have appeared several times in NATURE during the past year by Prof. J. R. Partington and have greatly interested me. The Pent'sao and similar books upon Chinese mineral drugs make repeated reference to the transmutation of metals into gold. However, few of these books have very old editions extant, so I have been looking up the subject of alchemy from other sources.

With the help of Mr Chen Yung, I have made the following abstracts from books referring to this

(1) 116 B.C., Ssu Ma Ch'ien wrote "The Shih Chi." He discusses the history of Ch'in Shih Huang Ti (221 B.C.) and states: "Hsu Shih led several thousand boys and girls to search for the immortals in the sea, where there were three mountains, P'eng lai, Fang shan, and Yin chou

"Ch'ın Shih Huang Tı was unable to find the miracle medicine 'ch'i yao' because things came to harm him; but after he had been protected from the

devils, he was able to find it.

"Lu Sheng wished Ch'in Shih Huang Ti not to let

others know where he lived, then he can obtain this

medicine of immortality, 'Pu ssu chih yao.'
"Ch'in Shih Huang Ti directed a large number of scholars and magicians to make the country peaceful

by producing the magic medicine

Li Shao-chun said to Han Wu Ti, cinnabar can be smelted to form pure gold; this made into eating utensils, when used will produce longevity: with longevity one is able to visit the immortals of the P'eng lai mountain, the worship of whom will bestow immortality.

"Then Han Wu Tı sent the Fang Shih into the sea to find the immortals of the P'eng lai mountain, and others he sent to smelt cinnabar with other medicines

to change them into gold.

'Although much money was spent they did not succeed in finding the immortals and immortality.

(2) 92 B.C. In the Shen-hsien-chuan we read that the "King of Huai nan," named "Liu an," kept several thousand people who wrote many books, of which eight chapters were upon the immortals and alchemy.

These writings are repeatedly referred to in other works. They are now lost, but their existence and

substance matter were definitely established.

(3) A D. 142. Wei-Po-yang wrote the "T'san T'ung Ch';" which he stated was the first book on internal alchemy (nei chin tan). It is included in the "Ssu-ku-ch'uan-shu" (the Imperial Encyclopædia), which establishes its reliability in the eyes of the Chinese. In the chapter upon "the creation of true earth" he refers to "the many fruitless attempts of men to make the philosopher's stone, by heating together Tangut ore, talcum, alum, magnetic iron ore, and sulphur These are useless, because they are foreign to the body. Used a thousand times they will fail ten thousand."

He believes in immortality from the true harmony produced by water and earth in the body, but he expressly opposed the alchemy of his day which tried

to produce immortality by chemical means.

Ko Hung, in writing "Pao P'u Tzu," states that
"Wei Po-yang was the 'Father of Alchemy,' and had three disciples who went into the mountains to make medicines. When made, they first tried them on dogs to see if they were fatal or immortal in their effects. Dogs died when fed on them; one of the disciples ate one and he also died. Wei Po-yang also ate one and died, etc. When they were being put into their coffins they resurrected." This account occurs in "Li-tai-shen-hsien-ch'uan," which is not so trustworthy as the "Tsan T'ung Ch'i."

I should like to emphasise in this material two

points ·

(1) Prof. Partington agrees that the accuracy of Ssu Ma Ch'ien's work seems to be unquestionable. In this we read, Ch'in Shih Huang Ti directed a large number of magicians to make the philosopher's stone. Now a large number could not have been in existence if alchemy had not been already well established by that time, 221 B.C., as concluded by the writers of the Bengal Monograph.

(2) The writings of Wei Po-yang are apparently quite authentic. The book I have quoted makes constant reference to the pill of immortality and the many schools which supported the use of mineral drugs to produce immortality, whereas the writer claimed the production of internal harmony as all important to immortality. His treatise implies a well-established school of alchemy in his day which also antedates

" Pao P'u Tzu.'

If the above evidences be accepted, it gives further strong support to the independent origin of Chinese alchemy, that it antedated the Egyptian school, and

that it certainly alose earlier than the conquest of Egypt by the Arabs, AD 640 It does not seem probable, when all is considered, that Beithelot was right in considering that Chinese alchemy was B. E. READ. derived from the Arabs

Peking Union Medical College, Peking, Oct. 22.

THROUGH the kindness of the Editor of NATURE, I have had an opportunity of seeing Prof Read's interesting letter. The citations which he gives from Sse Ma Tsien's chronicles (a careful translation of a portion of which by Chavannes has been published), and the reference to books on alchemy in 92 B.C., indicate an early date for the practical study of this subject in China. No one who has read the information available in translations such as these can, it would seem, agree with the hypothesis of Arabic transmission put forward by Berthelot on such slender evidence, and dogmatically repeated by later writers, some of whom have added to the confusion by citing the conclusions of authorities in a form which is the exact opposite of that held by the authors to whom reference is made. Anyone who is interested in Chinese alchemy is recommended to refer to careful translations of Chinese books, where these exist, and to ignore the very uncritical and garbled accounts of the subject given in recent com-pilations on the history of alchemy. I have already alluded in NATURE to the entirely independent support given to my suggestions by the valuable work of Stapleton and Azo. It appears that the ground is gradually being cleared, and if Chinese experts can be induced to render some assistance, a new chapter on the transmission of alchemy to the West may soon be written.

J. R. Partington.

## Dynamics of Whirlwinds.

IN NATURE of Oct. 8, J S. Dines gives an example of small whirlwinds in which the reduction of pressure at the foot of the central core was much greater than it could possibly have been at the top of the column, and further compares this with the case of an actual

tornado where the same thing evidently takes place. In the Quarterly Journal of the Royal Meteorological Society for 1896, page 71. W. H. Dines described an artificial tornado cloud which he produced by very simple means, and stated that this phenomenon was observable to a marked degree in his model. With a rotating column about two feet in height he found it possible to get a reduction of pressure equivalent to about 1 inch of water at the foot, while at the top the fan which was employed to cause the updraught was incapable of producing a suction of more than about d of an inch.

There is no difficulty in explaining the low pressure at the foot, but what we have to explain is why air does not flow down the core from the top and ultimately equalise the excess reduction of pressure. I suggest that the reason is to be found in turbulent motion of the air comprising the column. There are good reasons for supposing that there is considerable turbulence, and in such case there is no reason why a pressure gradient along the core should not exist.

Consider some definite portion of the vortical column, let r be the distance of an air particle from the central axis, p the pressure,  $\rho$  the density, and v the velocity component resolved perpendicular to the axis,

Then 
$$\frac{dp}{dr} = \frac{\rho \cdot v^2}{r}$$
. . . . (1)

The question now arises as to what relation exists

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If there be no turbulence the between v and rprimary determining factor will be the viscosity of the air, and this will always tend to make any section of the column rotate like a solid disc, that is, v/r will be

If, then, we neglect changes in  $\rho$  we have from (1) the equation

$$\frac{dp}{dr} = \rho \cdot k^2 \quad r, \text{ where } k \text{ is a constant,}$$

$$p = \frac{\rho \cdot k^2}{2} \cdot r^2 + \text{constant.} \qquad (2)$$

On the other hand, if the motion be turbulent there will be a continuous interchange of angular momentum between the different concentric shells, and the tendency will be towards the product  $(v \mid r)$  being constant.

In such case we should have

$$\frac{dp}{dr} = \rho \cdot k_1^2 \frac{1}{r^3},$$

$$-\frac{\rho \cdot k_1^2}{r^3} \cdot \frac{1}{r} + \text{constant}. \tag{3}$$

 $p = -\frac{\rho \cdot k_1^{\ 2}}{2} \cdot \frac{1}{r^2} + \text{constant.} \qquad . \label{eq:posterior}$ whence

Actually, it seems certain that some relation lying between these two extremes must exist, but since the viscosity of air is small it is probable that the conditions are more nearly represented by (3) than (2). It will be noticed that equation (3) implies the existence of a small intense core of low pressure, but that (2) does not, while we know from observation that such a core does exist in the centre of a whirlwind.

The high values of v/r near the centre and consequent low pressure could of course be produced without the aid of turbulence if some external source of energy continually extracted air from the centre, but since the pressure gradient along the core is of the wrong sign for this to happen, we are left with the inference that turbulent motion must be the true cause of it.

The outer shells of a whirlwind are known to have a helical motion upwards and around the core, and if it be granted that the whole motion is turbulent they will continually exchange momentum in the axial direction between themselves and the central core. This explains both the axial pressure gradient and the reason why air does not flow downwards towards the region of low pressure.

Another point was raised, but not answered, in the paper of W. H. Dines, referred to above; namely, the curious fact that the central core in his model tornado cloud was comparatively clear, while the surrounding shells were dense with cloud particles Now it is immediately calculable that if a suction of 1 mch of water can be produced in the centre of a whirl not more than a few inches in diameter (which was approximately the case in the model in question), the radial acceleration of the air comprising it must be of the order of 500 times that of gravity. Such an acceleration will throw all the larger water particles out of the air in the central region into the outer shells, where the acceleration is smaller; it would be interesting to know if the same thing happens in the ordinary small waterspout or dust whirl, and in the larger American tornado. L. H. G. DINES.

> Teddington, Nov. 7.

73 Fairfax Road,

#### The Struggle for Existence.

DARWIN attributed organic evolution chiefly to the combined action of variation and the struggle for existence, primarily the competitive struggle. This involves certain difficulties. First, the factors named tend to mutual exclusion—the more variation the less struggle. Secondly, were there no variation,

competition would be intense but barren; were variation so discontinuous as to exclude competition, many certainly of the variants would perish, but others would prosper, and since there would be greater variety than under competitive conditions, there would also be more abundant life and perhaps greater evolutionary progress. Thus, where competition is greatest the results for evolution are mil, where the results are greatest competition is absent.

The question then ensues, how does competition or, as I would call it, incompatible similarity, operate? In relation to variation, or rather to fit variation, incompatible similarity is perhaps best regarded as part of the environment. As such it is directly related only to the comparative fitness of certain variations fitly related to other environmental features; these variations it tends to specialise indefinitely, because adaptation to it only produces further incompatibility, necessitating further adaptation, and so on. But it is only on fit variations which, as discontinuous, considerably lessen, while not excluding, incompatibility that this incompatibility can operate. I assume discontinuity since the older view of natural selection as operating on minute innate differences is now found to involve serious difficulties, besides which I would suggest another, namely, that such differences would count for less than certain acquired differences—generally the surviving fittest would be those in the prime. Again, at least in progressive evolution, there is increasing environmental variety, partly due to the diffusion of life beyond the area in which it began into other and unlike areas, partly an actual increase in both organic and inorganic variety. There is also, I should suppose, at least until types have become much specialised, increasing germinal variation, attributable partly to greater environmental variety as affording richer means of subsistence. This general diminution of similarity involves a diminution of incompatibility, and therefore of its characteristic action upon variations. Decreasing fecundity as evolution advances also means decreasing similarity and incompatibility.

Regarding now the bearing of the above on the question how far relations of support, how far those of conflict are involved in natural selection. Fit organic variation obviously develops relations of support, at first one-sided, later becoming mutual as between organism and organic environmentwhile later again actual co-operation among organisms, chiefly similar organisms, emerges. Relations of support, however, involve acute conflict where one race supports another as prey. Competition in mtensifying certain qualities of fitness intensifies relations of support. Very largely, however, it affects such relations where they involve conflict, and this also it intensifies. Besides which it has itself an aspect of conflict, especially where there is direct That fit variation, so far as involving increased help, has been much the more important progressive factor is suggested upon comparison of the results of evolution on land with its results in the much more extensive and less divided sea, where, partly at least from the scantiness of plant-life, competition involving conflict in its severest form has altogether preponderated. This conclusion, I would note, might help to reconcile the scientific conception of Nature with its æsthetic appeal.

The noncompetitive struggle is perhaps not a factor in evolution at all. For the total organic production is here the real cause of evolution as including by the law of probability, apart from any orthogenetic or Lamarckian tendencies, the production of a certain proportion of fitly varying organisms.

The surviving fit—not fittest—here find Nature more helpful than hostile, and so strive perhaps rather than struggle, the unfit succumb without influencing the evolutionary process, in relation to which their struggle is therefore a useless by-product

P. J. Hughesdon.

41 Murray Road, Wimbledon.

#### Meteorological, Geological, and Biological Conditions on Venus.

The absence of oxygen in the atmosphere of Venus, as shown by St John's spectroscopic observations, and the consequent absence of life such as we know, are scarcely what one would expect at first sight on a planet so much like the earth in size and mass and having a mean temperature within the range of terrestrial abodes of life. An explanation, however, is suggested by further consideration of what might happen to the earth and its inhabitants if it could be transferred to the orbit of Venus, and also have its axial rotation speed reduced to one revolution in several weeks.

The changes of temperature produced by these two changes would of course be great, but would they alone eliminate life? The orbital change, doubling the supply of heat, would raise the mean temperature of the upper atmosphere by some 40° C., or perhaps less if we allow for an increase of albedo to that of Venus. This would leave even the tropics within the range of temperatures of such hot springs as contain life, and the polar regions would merely become comfortable.

The rotational change would increase the diurnal range of temperature seriously, but not so much as if the change of duration of the day's heat supply were the only factor to be considered. One mitigating factor is the increased moisture content, produced by the increase in average temperature. This would increase the thickness of the moist or cloudy region through which the solar heat must penetrate to reach the ground, or in which the radiation leaving the ground at night would be absorbed. The other mitigating factor is wind. On the earth as it is, the well-known deflexion of winds by its rotation limits greatly their ability to carry cold air to heated regions; on our hypothetical, transferred earth, this deflexion would be nearly eliminated. Thus the temperature differences would be so restricted by wind that it seems difficult to deny the existence of life on their account, especially in the polar regions.

The effects of this wind, however, would not all be so beneficial. For not only is the temperature range causing it great, even if not too great for life, but a wind blowing along the lines of the pressure gradient must acquire kinetic energy with far less loss by friction than occurs in our deflected winds. Hurricane strength at least, therefore, looks reasonable, and continual hurricanes would soon produce vast changes in our hypothetical, transferred earth. Vegetation on the land would be greatly impaired, leaving the surface exposed to wind erosion; in the tropics the increased violence and frequency of the thunderstorms (especially with increased temperature and moisture content) would add greatly to erosion by rain; along the coasts, likewise, wave erosion would be greatly accelerated. Altogether, would the continents endure? Or even if they could be maintained temporarily, by unusual orogenic activity, such as characterises the present geological epoch, could they endure under more normal conditions?

If they could not, the result would be a planet completely covered by its ocean, with water so rough as to give notable erosive action at depths at least comparable with that to which sunlight can penetrate Land plants would then be absent, and perhaps even shoal-water plants as well. and the question arises, Could the plankton algae produce enough oxygen by photosynthesis to show in St. John's spectroscope?

Furthermore, assuming they could, on this hypothetical transferred earth, would there be any plankton algæ on a planet that had never had any continents, and so had never had any quiet tidal pools, such as are often described as the probable origins of life on

the earth?

In short, is it not reasonable to suppose that Venus is a planet without land, without shoal water, and therefore without life? There are many questions here for the geologist and the biologist which a physicist cannot attempt to answer.

DAVID L. WEBSTER.

Stanford University, California, Oct. 24

#### The Tribal God.

I FEAR Prof. MacBride (NATURE, Dec 3. p. 807) has entirely failed to distinguish between speaking contemptuously of the Deity and of some people's conceptions of the Deity. He has also withdrawn from mine and Mr Squire's context the explanatory text. This is a common failing of the journalist, but

ought not to be of the scientist

My words in the lecture run as follows: "Nay, even to understand the Reformation itself you must appreciate that it was the replacement of a universal church by separate national churches, and in no forced sense a real return to tribal gods, invoked to support and render victorious their individual nations. Nay, if you kept your eyes open during the recent world war, I think you would have found many traces of religion as a tribal faith. This conception is strikingly expressed in the lines which Mr. J. C. Squire wrote in 1915 or 1916:

"God heard the embattled nations' charge and shout 'Gott strafe England' and 'God save the King,' God this, God that, and God the other thing. 'Good God!' said God, 'I've got my task cut out'"

To me, and I should imagine to many readers of Nature, the conception of a God of Battles, to whom appeal is made to aid one or another nation in killing millions of their fellow-men, is contemptible, the product solely of ignorance. It is as barbarous an idea as that of the Greeks of Homer's day that the gods could mingle in the fray of men, killing mortals and wounding each other. When Ares and Athene assist their rival heroes, surely Zeus has his task cut out! May I not say to Prof. MacBride as Diderot to the god-makers of his day: "Détruisez ces enceintes qui rétrécissent vos idées! Élargissez Dieu!"?

KARL PEARSON.

University College, Gower Street, W.C.1.

#### Flame and Combustion.

Doubtless readers of Nature will have noted that, although twice challenged by us to say what evidence there is for his notion that not 'hydrone' (steam) but something much more complex and 'hydronolic' (water) is formed by combustion in flames, Prof. Armstrong has vouchsafed no answer. If his fertile imagination cannot frame one we may be sure none is forthcoming, so that judgment will now go by

detault, however much in his closing speech he may gibe at his opponents

So far as we are concerned, whilst making no pretence of having solved completely the whole problem of the precise rôle played by steam in the combustion of carbonic oxide—preferring to keep our minds open to the new evidence which is now rapidly coming in from various quarters—we wish in a closing word on this part of the case to say that in our opinion a point has been reached when it can be said quite definitely that the cumulative weight of experimental evidence is so conclusive against Prof. Armstrong's extreme 'water-theory'—or indeed any other postulating that steam plays a necessary intermediary chemical rôle—that it may now be dismissed as one of those 'Phantoms of the Cave' arising (as Francis Bacon said) from "a fanciful Philosophy, which regards only a tew cases."

WILLIAM A BONE D. T. A. TOWNEND.

Imperial College of Science, South Kensington, London, S W 7, Dec 6.

# Sound Absorption Coefficients Measured by Reverberation and Stationary-wave Methods.

I have to correct the calculation of a reverberation coefficient of absorption given in my letter published in Nature of Dec. 3. Owing to a misprint in the paper from which I quoted (*Proc Roy. Soc*, 115, 418; 1927) the value of  $\alpha\Omega_2$  (the imaginary part of the acoustical admittance per unit area multiplied by the velocity of sound) for an experimental acoustic plaster was given as -0.0100, whereas it should have been -0.100. Also the factor  $(\Omega^2 + \Omega^2_2)$  occurring in the last term of the expression for the reverberation coefficient in terms of acoustical admittance should read  $(\Omega_1^2 - \Omega_2^2)$ 

The recalculated value of the reverberation absorption coefficient at 512 vibrations per second for the acoustic plaster is 0.37, which is very close to the reverberation coefficient quoted by Watson for 'Akoustolith,' namely, 0.36 For 'Akoustolith' itself I have found by the same method that the reverberation coefficient at 512 vibrations per second is 0.35.

E T. PARIS.

Biggin Hill, Kent, Dec. 6.

# A Change in the Refractive Index of Air when an Electric Glow Discharge is passing through it.

The change is studied by observing the shift in the interference fringes obtained by Jamin's plates. The change is purely local in the region of the luminous discharge. By varying the pressure inside the air-tube, it is found that the shift is a maximum at a pressure of the order of 2-5 cm. of mercury. Ionisation of the air by X-rays or by Tesla discharge does not cause any appreciable shift.

The shift does not appear to be due to any local changes of pressure. Whether it is purely a temperature effect is being studied. The shift was very small in the preliminary experiments, the maximum being only about a third of a fringe. A shift of two or three fringes has now been obtained and a higher

degree of accuracy is expected

J. B. SETH.

Physics Department, Government College, Lahore, Oct. 27.

## Jubilee of the Institute of Chemistry.

TUBILEES and centenaries, as they recur and pass, serve at least to make us look forward as well as backward, to envisage the probable extension of influence as well as to recollect the circumstances of the birth of some of our most familiar institutions The Institute of Chemistry has just celebrated its fiftieth birthday, as befits that age, in genial intercourse with the other members of the British branch of the chemical Fifty years is but a short life compared with the seniority which some corporate institutions have attained, but although it represents scarcely more than the passing of extreme youth it is, nevertheless, quite a respectable age when the modernity of the distinctive profession which it represents is taken into account. There was a time when chemistry was the spare-time accomplishment, so to speak, of the medical man or of the student of the diverse manifestations of Nature; now-so distinct are the details of their aims, their technique, and even their language—it is difficult enough for chemists of various tribes to find common ground in one another's interests. Yet all, as a unified but composite profession, are represented by this organisation; the works chemist, the public analyst, the consultant in metallurgy, in brewing, and other specialised branches, the instructor, the researcher, the professor, all meet within its fold

The Institute, however, does not serve merely the profession—It has been continuously active in the interests of the country, whose citizens have a very real interest in the maintenance of proper scientific control of its food, its beverages, its medicines, its manufactures; there is, in fact, scarcely any phase of our material interests which does not at some time or other come under the professional observation of chemists. That such control or examination should be adequate, and that the examiner should be highly competent and trustworthy in the exercise of his functions, briefly sums up the policy

of the profession.

The Institute of Chemistry of Great Britain and Ireland had its origin in a meeting, held in the rooms of the Chemical Society on April 27, 1876, to discuss the organisation of the chemical profession. Prof. Abel was in the chair A committee with Mr. (afterwards Sir) Walter Noel Hartley as secretary was appointed to confer with the Chemical Society, and as a result of their deliberations it was resolved to form a new association, to be entitled "The Institute of Professional Chemists of Great Britain and Ireland," with Prof. (later Sir) Edward Frankland as its first president; the present title was, however, adopted in deference to official representations. It appears to have been in Sir Edward Frankland's mind that the idea of such an institution was formulated at a dinner given in honour of Cannizzaro on May 31, 1872, when he expressed his conviction of the necessity for the creation of some such body as would correspond with the Royal Colleges of Physicians and

Surgeons, the Institution of Civil Engineers, and the Inns of Court

The new Institute was incorporated by licence of the Board of Trade under the provisions of Section 23 of the Companies Act, 1867, on Oct. 2, 1877, and was afterwards incorporated by Royal Charter on June 13, 1885, with authority to grant certificates of competency, and to register persons qualified to The membership roll now includes more practise than 5300 fellows and associates, and 800 students In recent years it has been found desirable to establish local sections, in order to facilitate intercourse between the members, and to provide opportunity for the discussion of matters of professional interest Local sections have thus been established as follows: Birmingham and the Midlands, Bristol and South-Western Counties, Edinburgh and East of Scotland, Glasgow and West of Scotland. Huddersfield, Irish Free State, Leeds Area, Liverpool and North-Western District, London and South-Eastern Counties, Manchester and District, Newcastle-on-Tyne and North-East Coast, Northern Ireland, South Wales, Cape of Good Hope, Malaya, and New Zealand, and honorary corresponding secretaries have been appointed to act throughout the Empire.

The patron of the jubilee celebrations is HRH. the Prince of Wales, KG; the present president of the Institute is Prof. Arthur Smithells, who is the seventeenth occupant of the presidential chair. The affairs of the Institute are in the hands of the president, six vice-presidents, a treasurer, and thirty-nine councillors, who number among them many of the names most honoured in the profession Mr. Richard B. Pilcher holds the office of registrar and secretary; parenthetically, Mr. Pilcher has a deserved reputation for an encyclopædic knowledge

of professional matters.

In the forefront of the Institute's work is the maintenance of a high standard of training and proficiency among members of the chemical profession. In this matter it does not intrude upon, but supplements, the work of the university and the technical college. It is not a training centre, but an examining body, particularly in certain specialised branches of vocational chemistry. Institute recognises the hall-mark of the university by admitting first and second class honours graduates, under appropriate conditions, to the associateship without further examination; in order to qualify for fellowship it is necessary to pass a searching examination in one of the seven branches, namely: inorganic chemistry, physical chemistry, organic chemistry, biochemistry, the chemistry and microscopy of food, drugs, and water, agricultural chemistry, and industrial chemistry. The examinations, if not held at distant centres, take place at the Institute's own laboratories, which, together with the council room, hbrary, and administrative offices, are located at 30 Russell Square, London, W.C. The Institute was formerly housed at 30 Bloomsbury Square. W.C; on the expiration of the lease of these less convenient premises, a fund was raised by private subscription among members and others, and the present building was erected in 1914–15

Another side of the Institute's activities is concerned with the maintenance of a strict code of professional conduct, with professional status, and matters germane to appointments in the public service. An appointments register is largely used by members and prospective employers, and a benevolent fund has been instituted so that temporary assistance can be given in case of need. The usefulness of the Institute is also apparent in the organisation, both at headquarters and at local sections, of lectures on matters of professional interest, and in the publication of 'Official Chemical Appointments' (a directory) and the registrar's useful guide entitled "The Profession of Chemistry." "Chemistry as a Career" is the title of a booklet containing a synopsis of lectures given by the registrar before college chemical societies during 1921-23 These books convey a warning as well as encouragement, for they clearly indicate that only a certain type of mind or personality can hope to attain even minor eminence, that material rewards are seldom of the richest and often of the poorest, and that real devotion to the spirit of service and inquiry is both expected and exhibited

Although the variety and importance of the services which the chemist renders to the community are even now but inadequately realised, the Institute of Chemistry has thus done much to define, to explain, and to improve his position in both public and private practice, it has equally endeavoured at all times to assist His Majesty's Government in matters on which chemistry has a bearing, and in return the work and qualifications of the Institute have been in a large measure recognised by the State At the time of its foundation, few universities and colleges provided satisfactory preparation for the profession of chemistry; indeed, it is difficult to realise what the position to-day would have been had this contribution to the development of systematic chemical education been withheld, and had no attempt been made to bring together in one body those who practise in a calling which is now acknowledged to be so vital to the progress of the civilised world. The strength and the future influence of the Institute will be fostered by the continued loyal co-operation of its fellows and associates in the maintenance of their own status and in the protection of such of the interests of humanity as are specially within their knowledge

## Belief and Evidence in Water Divining.

By Dr. Hugh Robert Mill.

T the Public Works, Roads, and Transport Congress recently held in the Agricultural Hall, Islington, the subject of water divining was introduced by Prof J. W. Gregory, who read a paper setting forth the admitted facts and stating his own reasoned judgment with the candour and conviction of an experienced man of science sure of his ground and satisfied with his conclusions So frankly did he acknowledge the widespread popular faith in the use of the divining-rod as a means of finding water that the writer of a leading article on dowsers and doubters in the Times of Nov. 25 appears to class him amongst the believers. Prof. Gregory, however, developed the case against the dowser with a convincing moderation and clarity of reasoning, and in the issue of Dec. 2 he stated that his paper showed "that the evidence of all the controlled experimental tests in England of which I know is against water or oil . . . divining."

This important paper may be summarised as follows. The literature of the subject is enormous, and Prof. Gregory, who appears by his citations to have been exceptionally well read in it, does not claim to have read one-hundredth part of what has been written. He relies largely on the recent book on the divining-rod by Sir William Barrett and Mr. Besterman, but brings much personal experience to supplement it. He points out that while at one time the expenses of a water-diviner employed by a public body were surcharged on the members, recent decisions have allowed the cost to be met from public funds, and a diviner

has even been employed in the crypt of St Paul's Cathedral to seek for the water channels below the foundations

The cause of the movements of the divining-rod may be explained in one of three ways (1) by fraud and practical jokes, (2) by unconscious imposture; (3) by some actual force which acts on the rod directly or indirectly. This third view Prof. Gregory was at one time inclined to share, believing that the diviner might possess some idiosyncracy in virtue of which he might be affected by slight sharply contrasted differences of moisture in the atmosphere, but he abandoned it because it would not explain the response of the divining-rod to things other than water, and would not account for water-diviners obtaining results in rain; moreover, it was dismissed as improbable by three eminent physiologists whom he consulted.

There are three rival lines of explanation: (1) that the rod responds to some physical stimulus, possibly allied to radioactivity, as upheld by M. Henri Mager As such matters were remote from Prof Gregory's own province he submitted Mager's book "Les Baguettes" (1920) to Prof. Desch, who found that its arguments did not furnish any support for the view that the diviners have any powers of detecting water or minerals. Mager's claims were also dismissed as extravagant and absurd by the U.S. Geological Survey; (2) that the movement of the rod is due, though perhaps unconsciously, to the diviner. This is the view elaborated by Barrett and Besterman, who

which is a second

dismiss the evidence for an external physical force by arguments which seem unanswerable claim is that the diviner has a sort of second sight. the evidence for which is on a par with that brought forward by spiritualists for their alleged clairvoyance; (3) that the diviner unconsciously or subconsciously moves the rod owing to an impulse due to unintentional suggestion from the bystanders or by his recognition of indications favourable for water. The process of subconscious movement of the rod by the dowser is explained by Dr Millais Culpin in his "Spiritualism and the New Psychology" (1920), as an example of the dissociation of the various streams of activity which flow side by side in the human brain, and Prof. Gregory considers that some of the best dowsers, like Mullins, probably act by this process, giving expression to the results of long experience or special quickness of perception of signs of water at the surface

Prof Gregory goes on to examine the evidence as collected in Barrett and Besterman's book in order to determine which of these conflicting explanations is the most reasonable, and he deals in turn with a series of experiments on which the authors of that book relied as examples of the triumphs of the dowsers over the geologists as water finders. His decision is that the happy selection of the sites in the four cases considered was in accordance with common sense and did not require cryptæsthesia. He cites a number of independent tests of the powers claimed by waterdiviners, and shows that both geological surveys and individuals have on many occasions proved the madequacy of the claims made. Similar tests with regard to dowsing for mineral oil were equally negative. It is pointed out that testing the divining-rod is difficult and promises no answer that will be universally accepted because the claims of different diviners are so contradictory and elusive that any test may apply only to the individual tested, and perhaps to him only on a particular day. It is pointed out that in the case of the Abbé Paramelle, claimed by Barrett and Besterman as a diviner who did not use a rod, the Abbé's own explanation that he found water by studying the indications of the surface is perfectly satisfactory.

As regards the nature of divining, Prof. Gregory says that the successful water-diviner is probably a quick observer who has usually had considerable experience in the search for water, and as he goes over the ground he probably recognises clues to the presence of underground water which subconsciously lead to movements of the strained muscles of the hands holding the rod In some cases such an experienced dowser will probably score no higher a proportion of successes than a competent geological expert would do, while in other cases the reputation of the diviner is made by lucky coincidences which are remembered and exaggerated while the failures are forgotten. It is concluded that although the claims of the divining-rod are invalid, an expert diviner may be useful under some conditions.

The outcome of Prof. Gregory's discussion seems to be that the use of the divining-rod is a survival of primitive magic, and that there is no reason to suspect the existence of unrecognised properties of matter or power of mind from the experiences and From the point of view performances of dowsers of the geologist it seems both reasonable and right to decide that further investigation of the diviningrod is waste of time and that his special knowledge can be of more service to the advancement of science if applied in other directions Nevertheless, there are other points of view, and recent advances in physical and psychical science may enable a keen and cautious investigator to reach some more positive conclusion than the evidence now available justifies. Instead of taking as the subject of study the exploits of the expert dowser who has an axe to grind, or of the amateur enthusiast who has a theory to uphold, might it not be better to try some simple person who, while not using it for pay or reputation, is possessed of the gift—if gift it be—of finding a divining-rod turn in his hands in the neighbourhood of underground water?

Stress is usually laid on the erratic or even contradictory results of many of the experimental tests which have been made, as opposed to the certain and repeatable results of scientific demonstrations. But scientific demonstrations of this kind only become possible when all the conditions are known and are under control Is this yet possible in the measurement of perception? If not, may not indications be found sometimes which indicate true relationships, though on a second attempt the demonstration may fail utterly? Every listener to distant broadcasting stations knows that for a week at a time he may pick up Cork every night and fail to find Belfast once, whereas at another time, though using exactly the same settings and the same battery strength, he may hear Belfast every evening and never get Cork at all. My view is that the facts which have been proved as to water divining are deserving from the strictly scientific point of view of as full and specialised attention as are the facts relating to electric waves. It would be very satisfactory if it could be established that Prof. Gregory's belief is correct and that the waterdiviner succeeds by his quick, even if unconscious, recognition of surface signs that may escape the ordinary observer. It would be equally satisfactory if it could be shown that the nervous system is capable of detecting radiations of a different frequency from those of light and heat, and that water, and perhaps other substances, may emit such radiations at ordinary temperatures one suggestion does not seem to be intrinsically more improbable than the other. The research would of course be very difficult, and the first-class minds which alone could pursue it to a satisfactory conclusion can probably devote themselves to much more productive investigations at the present time.

If there is anything in these phenomena, the discovery will undoubtedly be made in the fullness of time, possibly many years hence; but meanwhile,

it is at least satisfactory to find that attention is being paid to things which are involved in such baffling perplexity that the easiest course is to look the difficulty steadily in the face and pass by. When the investigator emerges who is able and willing to tackle the problem, he must not be afraid of finding results which his present knowledge may lead him to think as absurd as the properties of radium seemed before they were discovered

In the course of correspondence in the *Times*, induced by the article on dowsers and doubters already referred to, Mr A. A Campbell Swinton outlined in the issue of Nov 30 a scheme of m-

vestigation which he suggested might be taken up by the National Physical Laboratory He proposes the construction of an underground channel through which a controlled supply of water might be allowed to flow or percolate in such a manner that the fact of sensitiveness to the presence of water could be tested and, if found, the rate of transmission of the impulse from the water to the dowser might be measured. If this suggestion were acted upon, a committee, which would satisfy both the credulous and the sceptical, could no doubt be brought together to arrange details of the tests

## The Use of Radio-Elements as Indicators.1

By Prof. FRITZ PANETH.

THE use of radio-elements as indicators is a special chapter of radioactive investigation, which differs from the topics usually treated under the name of radioactive research, in so far that the radio-elements are here not the object of the study, but are used as a mere agent in the solution of problems which in general have nothing to do with radioactivity at all. These problems may be found in very different branches of chemistry, physics, and even biology, and it is to be expected that radio-elements as indicators will be more used the more familiar the advantages of this method become to non-radiologists.

Only an elementary knowledge of the principles of radioactivity is necessary in order to understand and even to apply the method. It is based upon the extreme sensitivity of radioactive measurements, and upon the chemical relations of the

radio-elements to ordinary elements.

As to the first point, it is well known that by help of an electroscope, invisible and imponderable quantities of radioactive matter can be detected and exactly measured. From the radioelement thorium C, for example, which can very frequently be used as an indicator,  $10^{-17}$  gm. allows for exact qualitative and quantitative determination. Now thorium C is 'isotopic' with ordinary bismuth. Since isotopes show identical chemical properties, it is possible to substitute the radio-element for its inactive isotope, and to acquire information concerning the element in extremely dilute solutions. The chemical behaviour of bismuth may thus be elucidated by a study of thorium C. In certain cases it is found advantageous to mix a certain amount of the radioelement with a sample of the inactive element in order that an otherwise indeterminable fraction of the original quantity may be detected or determined electroscopically. Instances in which such minute fractions of an element have been separated by some such process as diffusion, solution, or volatilisation, are discussed below. By choice of the appropriate ratio between the quantities of inactive element and radio-element in the sample, it is possible to cover the entire range of mixtures from those detectable only by means of the electroscope to those containing readily weighable amounts of material.

In selecting a radio-element for use as an indicator, it is generally desirable to find one that may be detected in very small amounts. It must be borne in mind, however, that the half-value period (T) varies inversely with the intensity of radiation, and that an element detectable in small quantities invariably has a short half-value period. It would therefore never be feasible to employ radium C'  $(T=10^{-7}\ {\rm seconds})$  or thorium C'  $(T=10^{-11}\ {\rm seconds})$  as indicators. Even the three indicators available for the element thallium are too shortlived for a number of experiments.

For this reason it is not practicable to use all of the elements included in the well-known lists of radioactive isotopes for the present purpose. Only the elements named in the following table can find practical application. Those to be recommended

most highly are underlined in the table.

Even radio-elements such as ionium, uranium  $X_1$ , and uranium  $X_2$ , which possess no inactive isotopes, frequently are of service in increasing the radioactive intensity of their longer-lived, less active, and therefore less readily detectable radioactive isotopes. Uranium  $X_1$ , for example, is mentioned in the table as a satisfactory indicator for thorium. So also, thorium X may be used as indicator for radium, and radium A for polonium. But radium and polonium themselves may in a broader way be employed as indicators in certain lines of work. For, in the narrower sense, the function of the radio-elements 'as indicators' may be conceived to be restricted to those experiments in which the radio-elements are substituted for their active or inactive isotopes. In the broader sense, however, this function may be extended to cover any procedure in which the radioelement is used as an instrument in the detection, determination, or investigation of matter in minute quantities.

A brief account of some examples, where radio-

<sup>&</sup>lt;sup>1</sup> From an address delivered to the Bedson Club, Newcastle-upon-Tyne, on Mar. 17, 1927. A fuller discussion of the subject in English by the same author, with references to the literature, will shortly appear in Volume 2 of the Baker Lectures, delivered by non-resident lecturers at Cornell University (Ithaca, N.Y). For literature, see also G. Hevesy and F. Paneth, "Manual of Radioactivity" (Oxford, 1926).

elements have actually been used with success as indicators—rather than an abstract discussion of possible applications of this method—may help to a fuller understanding

From the large number of experiments with radio-elements as indicators in the field of analytical chemistry, the choice of one typical case may well suffice. The solubility of lead chromate at room temperature is too small to admit of accurate determination by simple gravimetric methods. It is of course possible, in cases of this sort, to make use of conductivity measurements, or to calculate the solubility product from the equilibrium constants. With concentrations as low as that of the

RADIOACTIVE INDICATORS.

Element	Indicator				
Thallium	Radium C' Thorium C'' Actinium C''	T = 1 32 m $3.20 m$ $4 76 m$			
Lead	Radium $B$ Radium $D$ Thorium $B$ Actinium $B$	26 8 m 16 0 y 10 6 h 36 0 m			
Bismuth	Radium $C$ Radium $E$ Thorium $C$ Actinium $C$	19 5 m 4 85 d 60 5 m 2 16 m			
Polonium $T = 136 d$	Radium A	3 05 m			
Radon 3 85 d	Thoron Actinon	54 5 s 3.92 s			
Radium 1580 <i>y</i>	Thorium X Actinium X	3 64 d 11 2 d			
Actinium 20 y	Mesothorium 2	6·13 h			
Thorium 1 65 × 10 <sup>10</sup> y	Ionium Radiothorium Radioactinium Uran. $X_1$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			
Protactinium $1.2 \times 10^4 y$	Uran. $X_2$	1 17 m			

saturated solution of lead chromate, however, either of these methods would entail a lengthy and delicate investigation. With the aid of a radioactive indicator, on the other hand, the solubility of lead chromate may be measured with no more difficulty than that involved in a simple weighing.

To a definite amount of a soluble lead salt, a known quantity of thorium B is added. The activity of this preparation may be measured in any desired units, as, for example, the number of scale divisions per minute on the particular electroscope used. If, for example, 10,000 units of thorium B is thoroughly mixed with 10 milligrams of lead, it is apparent that one unit of thorium B will invariably indicate the presence of 0.001 milligram of lead. From the artificially activated lead thus obtained it is now possible by the usual chemical methods to prepare the chromate. After

the saturated solution of this compound has been held at the desired temperature in a thermostat for a sufficient time, its composition may be ascertained by evaporating a few cubic centimetres to dryness, and measuring the activity of the wellnigh invisible residue in the electroscope. (This example is treated in more detail because the general procedure is typical also of the following cases)

Had the radio-elements been available for use as indicators during the last quarter of the nineteenth century, one extremely important service might have been rendered with their aid, to the then newly advanced theory of electrolytic dissociation. Proof of the actual fact of dissociation, and of the interchange of ions, is readily obtainable with the help of the radio-elements, mixed, in accordance with the procedure just outlined, with their inactive isotopes It is possible to demonstrate in this way the fact that the particular atoms or radicals assumed to be liberated by electrolytic dissociation do not retain their places in given molecules, but are free to move back and forth from one place to another. If, for example, equimolecular amounts of an mactive lead chloride and a radiochemically sensitised lead nitrate in aqueous solutions are mixed together, and the lead chloride is allowed to crystallise again, it will be found that the active lead atoms are distributed proportionally between chloride and mtrate, and must therefore have migrated in solution from lead nitrate to lead chloride until the kinetic equilibrium has been

Radio-elements have further shown their utility in connexion with measurements of the surface of powdered adsorbents. concerning the extent of surface is obviously necessary in deciding whether the adsorbed layer is of the thickness of one, or of more than one molecule. This question has been answered in various ways by various theories of adsorption Particularly in the case of powders, which, because of their greatly extended surface, are preferentially used as adsorbents, determinations of superficial magnitudes have hitherto been unsuccessful. If the choice of materials be limited, however, to solid compounds of elements possessing a known radioactive isotope, a safe and simple method becomes available. It is based upon the fact that the radio-element, added to the saturated solution of the isotopic adsorbent, becomes in a very short time equally distributed between the molecules of the dissolved part of the adsorbent and those of the uppermost layer of its crystalline surface. In this way the extent of the surface can easily be computed from the decrease of the radioactivity of the solution. The surface of the sulphate and sulphide of lead, of the phosphate of bismuth, and so on, have thus been measured, and with these values it has been able to establish the fact that on all these adsorbents the limit of adsorption is reached as soon as a layer of one molecule in thickness has been formed.

From the chemistry of inorganic preparations, the discovery of the volatile hydride of bismuth

with the help of its isotopic radio-elements may be mentioned From many fruitless investigations it had to be concluded that this compound, if it could be prepared, would be obtained only in very minute fractions of the initial material, and might therefore easily escape detection by the usual The apparatus for measuring methods of analysis radioactivity can, however, be selected so that a ten-millionth part of the bismuth in the original material will give a product recognisable with certainty, both qualitatively and quantitatively This wide extension of the range of measurement is quite necessary if the condensation and re-volatilisation of bismuth hydride are to be detected, its mere existence can be proven by relatively simple means and even by a lecture experiment Decomposition of magnesia turnings, covered with thorium C or radium C, by dilute hydrochloric acid, yields the volatile hydrides of these radio-elements, which can be condensed at the temperature of liquid air and—on the other hand—decomposed and measured in a heated glass-tube After experience had been gained with the radioactive method described above in the study of the best method of preparation, and of the stability of bismuth hydride, it was found possible later, with comparatively little difficulty, to prepare this compound also from inactive bismuth, making use of magnesium as before in the preparation of the hydride. It may be mentioned that the amount of material by which the existence of the compound was first recognised was but 10<sup>-15</sup> gram, and that it was found possible, with further increase in the sensitivity of the process of detection, to establish by the use of radioactive indicators the existence of a gaseous lead hydride formed in still smaller amounts. Here also the radioactive test was a spur to ultimately successful experiments with ordinary lead.

That radioactive indicators might occasionally serve to advantage in technological research can scarcely be doubted, even if they have been more frequently applied hitherto to scientific problems. A question of this type is that of testing rubberised fabrics for their permeability to gases. When, during the War, in connexion with the choice of suitable samples of material for gas masks, the task of determining numerically the permeability to gases of the materials submitted by different firms was assigned, it was found convenient to employ, as a test gas, air with which was mixed a trace of radium emanation (radon). The fractional portion of the gas which penetrated the material under investigation could then be determined electroscopically.

A considerable number of problems in physics can be brought to solution through the agency of radioactive indicators. Among these, the experimental study of 'self-diffusion' is of paramount importance. By this is understood the phenomenon, expected from the kinetic theory of matter, that the atoms of a homogeneous gaseous or liquid element move among one another under the same law that applies in the case of a diffusion of one element into another. Since in self-diffusion, how-

ever, the external properties of the element in question remain entirely unchanged, it has been possible to carry out this process hitherto only as an imaginary experiment, of which indeed Maxwell and Boltzmann have made frequent use G. Hevesy, the author of many experiments with radioactive indicators, has succeeded in bringing self-diffusion within the scope of observation prepared and sealed in a hard glass tube, a fused cylinder of lead, of which three-fourths was ordinary lead and one-fourth activated lead, thorium B was used as radioactive indicator in experiments of only short duration, while the long-lived radium D was chosen for more extended experi-If now the lead in the tube is cautiously melted, and is held at this temperature for several days, it is easy, after solidification, to measure the distribution of the activity that has taken place within the lead column during the period of the experiment. In this case, therefore, marked lead atoms have diffused among other lead atoms, and the self-diffusion constant can be calculated by the usual methods.

Among other applications to physical research which can only be mentioned here, are the formation of various alloys at low temperatures, the speed of solution of very thin layers, the rate of evaporation in relation to the amount of liquid to be evaporated, and diffusion in ideally dilute solutions.

Since bismuth compounds of very diverse composition have recently been investigated from the viewpoint of therapeutics as a substitute for arsenic, it was of interest to physiologists to learn in what proportions the bismuth introduced is stored up in the different organs of the body, and is eliminated in the urine and fæces. Since small amounts only are involved, the determination can best be accomplished by the radioactive method. Radium E was employed as indicator for bismuth in place of thorium C, in view of the fact that the experiments extended over a period of several days It was mixed with the bismuth preparations and injected intra-muscularly into the guinea-pigs employed in the experiments The products of excretion were ashed and measured electroscopically, and after the end of the experiment the organs of the animals were similarly treated One conclusion to be drawn from the chart showing the exact distribution of the bismuth, is that the accumulation of this element takes place chiefly in the kidneys. Analogous experiments with lead preparations show that absorption takes place chiefly in the liver. The absorption and distribution of lead in roots, leaves, and fruits of a plant (Vicia faba) were investigated in a similar wav.

The examples of the use of radio-elements as indicators here presented may suffice to show that the method thus illustrated is capable of many-sided application. It is to be hoped that in the future a greater number of chemists and physicists than heretofore may make use of the method, and may thereby facilitate materially the solution of many problems.

## Obstuary.

### Prof. K D. Glinka.

SOIL students in all parts of the world will learn with deep regret of the death of Prof K D. Glinka on Nov 2 He had for some time been in failing health and had felt some heart strain, but none of those who met him last June and July at the Soil Congress in the United States had any suspicion that he was so near the end. All who attended were prepared to accord him their deepest respect for his profound knowledge of the subject and his own brilliant work and though they were with him but a very short time, his unfailing courtesy and his kindly good humour had endeared him to everyone who met him

Glinka was born in 1867 in Smolensk, the son of one of the most ancient and honoured aristocratic families of the old regime in Russia 1 He studied first at the University of St. Petersburg, which he left in 1889, and afterwards at the University of Moscow, where he obtained his doctor's degree in mineralogy. In 1900 he was appointed professor of mineralogy and geology at the Agricultural Institute of Novo Alexandria in the Government of Lublin, which since the War has again become Polish territory, and has therefore resumed its old Polish name Pulawy: the Institute, under this name, has now become the central agricultural experiment station of Poland . Within two years of his appointment he was, at his own request, and in consideration of his studies on soil, transferred to the chair of pedology at the same institute. Between 1908 and 1914 the Emigration or Settlement Board of Russia arranged a series of expeditions to study the soils of Russian Turkestan, putting Glinka in general charge; this, however, did not necessitate his giving up his professorship. He made the big expedition of 1909, travelling from Kabousaya to Vernogo, thence through Lepsinsk to Sergiopol, and finally Semipalatinsk. The material collected in this and the other expeditions was worked up by the Dokuchaiev Pedological Committee. Reports were issued in his name from 1908 to 1914: a general summary is given in Russian and German in La Pedologie, 1912, vol. 14, pp. 43-63 He became president of this Committee in 1912, and relinquished the chair at Novo Alexandria; in 1913 he went to the Agricultural Institute at Voronesh, the soils around which he studied: in 1922 he returned to Petrograd as director of the Agricultural Institute: this post he was holding at the time of his death

Glinka was essentially a field worker, studying the section or profile of the soil from the surface to a depth of some six or eight feet His methods are well illustrated in his paper "On the So-called Brown Earth," which appeared in La Pedologie, 1911, vol. 13, p. 17 (Russian and German)

had an amazing capacity for seeing things in a soil section that ordinary workers miss: the present writer had numerous opportunities of admitting Glinka's superiority as an observer during the Soil Excursion in the United States last summer. Glinka himself did but little laboratory work on soil, but his marked ability to use the results of others is illustrated in his studies of the differences between podsols and peaty soils, published in

La Pedologie, vol 13, p. 1.

In 1914 Glinka's book "Die Bodentypen" was published in Berlin, unfortunately its value was not at first recognised by British students, none of whom had at that time any adequate knowledge of the Russian soil work. It was not until the International Soil Conferences were resumed that this defect was remedied, now the Russian work is accorded full recognition, and some of the presentday investigators not only use Russian terms for the soil groups, but are also studying the Russian language in order to read papers that are not translated

The chief difference between the Russian and the British soil work is that the latter has been chiefly directed to the study of the soil as a medium for plant growth, while the Russians have studied the soil as a distinct natural object without regard to questions of fertility The difference arose from the circumstance that the early fertiliser experiments at Rothamsted and elsewhere had given striking increases in crop production, while those in Russia had not. The British workers therefore concentrated on soil fertility, which they were learning to control: the Russian workers took another direction. These studies began soon after 1861, when the serfs were emancipated by the Tsar Alexander II. The Free Economical Society was formed, and arranged with D. L. Mendeléeff, then a young man, to carry out fertiliser experiments in various parts of Russia. These experiments failed to give the definite positive results obtained m England and elsewhere, and Mendeléeff discontinued the work and returned to pure chemistry to discover the Periodic Law It is interesting to speculate what might have happened in the history of science had the fertiliser experiments come out more definitely and Mendeléeff become an agricultural chemist. Later on the Society arranged with V. V Dokuchaiev to study the chernozem—the black earths of Russia, on which wheat is so much grown.

Had this investigation been made in England, it would almost certainly have resolved itself into a study of the crop-producing power of the soil; in Russia things happened otherwise, and Dokuchaiev, disregarding relationships to plant growth, studied only the soil itself, and discovered the existence of layers more or less parallel with the surface and all related one to the other. Over considerable areas of Russia he and his pupils found similar morphological characteristics, on the basis of which, rather than of geological origin, they

¹ By a curious enor in journals m, for which it is difficult to account, one of the best American daily papers, in dealing with the Soil Congress, described Glinka as the son of a peasant — This description was copied in other papers and read out at certain of the functions, much to his amusement.

classified the Russian soils P A Kostychev studied these relationships chemically. A close connexion was found between the soil types and climate, and the generalisation gradually emerged that the soil is largely a function of the climate, this being more important than the parent rock

This remains the fundamental thesis of the Russian workers If the climate be known it is possible to predict what the soil type will be. Further studies have revealed discrepancies which, however, are courageously dealt with, where it is not possible to explain the soil on its presentday climate, as in the case of the so-called degraded chernozem, a change of climate is postulated to The British soils account for the observed facts present considerable difficulties, many of them being so closely dominated by the properties of the parent rock that the geological classification is still the best, but they are being studied by the Russian methods It is now universally recognised that the Russian pedologists have added much to the resources of soil science, and among the foremost of the pioneers Glinka's name will always be counted. E. J. Russell.

## LORD KENYON, K.C.V.O.

LORD KENYON of Gredington, Flintshire, who died on Nov. 30, aged sixty-three years, was a country gentleman with a fine record of public service in respect to agriculture and Welsh institutions such as the University and the National Museum of Wales. He was Lord Lieutenant of Denbighshire, and had been Lord-in-Waiting to three sovereigns.

The first Lord Kenyon of Gredington was the great jurist; the late peer, the fourth holder of the title, succeeded his grandfather in 1869 at the age of five. He was educated at Eton and Christchurch, Oxford, and was created K.C.V.O. in 1907. His interest in agriculture led to his appointment when a young man as a member of the Welsh Land Commission. In 1924 he was chairman of the Advisory Committee on Milk Production and of

the Agricultural Wages Board.

As Pro-Chancellor of the University of Wales, Lord Kenyon did a great deal to foster and encourage scientific research in the University. He realised very clearly that one of the chief aims of a university must be the attainment of truth and the extension of knowledge. He took a particular interest in the new science buildings at the University College of North Wales, Bangor, which were opened in 1926, and in the well-equipped laboratories which have been set up at Swansea during recent years. He also watched with growing interest the rise of the new physics and chemistry buildings at the University College of South Wales and Monmouthshire, Cardiff, which are at the present time nearing completion. His great mterest in the Welsh National School of Medicine was largely due to the fact that he realised the great services that by means of scientific research and investigation such an institution is capable of rendering not only to the solution of health prob-

lems in Wales, but also to the cause of medical science generally. For this reason he was a strong advocate of what is known as the 'medical unit system.'

Few realised more clearly than Lord Kenyon the function of a university in the life of the community, as a place for guarding and increasing our inheritance of knowledge and for keeping that knowledge alive. He was a great believer in postgraduate scholarships for research, and nothing gave him greater pleasure than to announce gifts made from time to time for the endowment of such scholarships. He secured many such gifts for

the University of Wales

Lord Kenyon's services to the National Museum of Wales at a critical period in its development He was elected president were no less valuable of the National Museum for the five-year period which terminated on Sept 30 last. Though he had had no previous connexion with the institution, he at once set himself to grasp the problems and needs of the Museum and threw himself heart and soul into its work. When he took office, only the western wing of the Museum building in Cathays Park, Cardiff, was in use The great part of the south front was a mere shell, and there was at that time no possibility of finishing it. He was foremost in urging on all interested in education in Wales that the completion of a sufficient portion of the building adequately to illustrate the environment and history of man in Wales, and the achievement of the people of Wales in the arts and crafts, was vitally important. Generous benefactions having enabled this work to be carried out, it fell to Lord Kenyon, as president, to receive their Majesties the King and Queen on the occasion of the opening ceremony in April last, and it is a source of great gratification to all concerned that he should have been able, before his death, to see this national institution happily launched on its career

Lord Kenyon proved an admirable president; he never spared himself in the services of the Institution, and attended every meeting at which his presence was desired, even at great personal inconvenience. Though the intra-mural work of the Museum was his chief interest—his personal inclinations leant towards art and archæology—his long experience of administration and of Welsh life and culture, led him to support in the warmest possible way the efforts made to extend the extramural activities of the Museum by the scheme successfully launched during his presidency of affiliating to the Institution the local museums in

Wales

Lord Kenyon's imposing figure, charming manner, and unfailing courtesy endeared him to all classes of the community. By his death Wales loses one of her most conscientious, painstaking, and influential public men, who combined the prestige of a great name with an exceptional personality. In the words of one who knew him well: "He brought to the service of the Welsh people the qualities which in the past made leadership easy and natural to aristocracy."

C. F.

J. J.

### News and Views.

At the Savoy Hotel, London, on Dec. 10, a private demonstration of a new musical instrument was given by the inventor, Prof. Leo Theremin, of the State Institute of Technical Physics, Leningrad. The apparatus, designed for "drawing music from the ether solely by free movement of the hands in space," proved to be a loud-speaker connected with a thermionic valve circuit which included a metal rod, the electrostatic capacity of which is altered by the proximity of the performer's hand, the whole arrangement being an application of the familiar 'howling' of a badly adjusted broadcast receiving set when the hand is brought near to the tuning condensers. The intensity of the sounds is controlled by varying the position of the other hand in relation to a metal hoop. or varying the pressure of the foot upon what appeared to be a disc of carbon For notes near the middle of the musical scale, the hand is at a few inches from the rod and a change in this distance of an inch or so alters the pitch of the note by a tone, the whole range being apparently about an octave. Faulty intonation occurs, therefore, unless the performer judges accurately the required distance from the rod for the desired frequency of oscillation. Wide variation of tone quality was shown to be producible, but the demonstration was limited to the performance of slow vibrato melody only. Prof. Theremin's apparatus is an ingenious application of well-known electrical effects, and it evidently possesses possibilities of development as a musical instrument, though of course harmony cannot be produced by it.

The discovery of a large area of nitrate, 120 miles east of Alice Springs, the administrative centre of the new territory of Central Australia, has been confirmed by Sir Douglas Mawson, who has visited the locality. The existence of the nitrate was indicated by the report of an aboriginal that the earth ignited when thrown on the fire. Sir Douglas Mawson identifies it as potassium nitrate, and its value is estimated as from £60 to £90 a ton. Potassium nitrate occurs naturally in Bengal, where it is formed by the decomposition of excreta in the presence of nitrifying bacteria. Potassium chlorides occur in basins and in arid areas by the evaporation of waters which drain from rocks rich in potash. The new Australian deposit may have been formed in a basin by the decomposition of the animal remains in swamps This discovery justifies the recent decision to extend the railway from Oodnadatta, the present northern terminus of the South Australian railways, to Alice Springs, and will probably lead to the completion of the long-projected and promised railway from South Australia across the centre of the continent to the Northern Territory.

The retirement of Dr. L O Howard, Chief of the Bureau of Entomology, U.S Department of Agriculture, took place on Oct. 17 last. After graduating from Cornell University, Dr. Howard joined the Department of Agriculture in 1878 and became Chief of the Bureau of Entomology more than thirty-three years ago. We are glad to learn that his retirement

does not involve cessation of his entomological activities, and that he will now have opportunity to carry out researches for which his official life afforded him so little leisure. His frequent visits to Europe and his extensive travels upon that continent have made Dr. Howard one of the most familiar figures at congresses, and probably no living entomologist is more widely known personally among his fellowworkers. His unpretentious office in the Bureau of Entomology at Washington has for many years been the Mecca of all entomologists who have visited the continent of North America. In his earlier days he was well known as a leading authority on the Chalcidoidea, but as the years went on he exercised a wide influence on many branches of entomology in his His influence on the subject executive capacity extends far beyond the United States, and one of his greatest aims has been to further the interchange of ideas between men of diverse nations. Dr. Howard carries the good wishes of entomologists throughout the world on entering his retirement.

Dr. C. L. Marlatt, who succeeds Dr. Howard as Chief of the US Bureau of Entomology, is a graduate of the Kansas Agricultural College and an administrator of wide experience. He has for many years been associated with the U.S. Department of Agriculture, and for the last five years has been associate chief in charge of the executive work of the Bureau of Entomology. Dr. Marlatt is the author of a number of official bulletins of the Bureau, and was instrumental in the drafting and administration of the Plant Quarantine Act of 1912 He also holds the position of chairman of the Federal Horticultural Board.

On Dec. 23 occurs the centenary of the death of Robert Woodhouse, the Cambridge mathematician, who was successively Lucasian and Plumian professor and was also the first director of the Cambridge Observatory. Born at Norwich on April 28, 1773, the son of a linen-draper, Woodhouse was educated at the Grammar School, North Walsham, and entered Caius College, Cambridge, in 1790. He took his degree in 1795, being Senior Wrangler and Smith's prizeman, and was made a fellow of his College. His services to mathematical studies at Cambridge have often been commented on. Ball refers to him as "the apostle of the new movement," while Peacock said that his "Elements of Trigonometry" contributed more than any other book to revolutionise mathematical studies in Great Britain. He is entitled to the entire credit of introducing the calculus into England, and his efforts were ably seconded by Babbage, Peacock, and Herschel, who formed an Analytical Society, with the object of advocating the general use in the university of analytical methods and of the differential notation. Woodhouse died at the age of fifty-four years and was buried in the Chapel of Carus College.

In his presidential address to the Newcomen Society on Dec. 7, Mr. J. W. Hall dealt with the history of the making and rolling of iron. Starting with the Middle Ages, when iron was more expensive than lead, costing

more than £100 a ton, he traced the various improvements in the making of iron down to the present time The output for centuries was very small and, even in the middle of the eighteenth century, the production for the whole of Great Britain was but 250 to 350 tons per week. With the introduction of Cort's process of 'dry' puddling on a sand bottom in a reverberatory furnace, iron could be produced in larger masses, and Cort showed for the first time how bars could be produced entirely with the use of pit coal All iron was worked under the hammer, but for small rods recourse was had to the 'slitting mill.' Sheets and bars of lead, tin, and copper were rolled long before iron bars, and the first iron rolling mills simply finished to size bars previously hammered to form and dimensions The merit of Cort's second invention was that he reduced the raw iron in a series of rollers with gradually decreasing grooves, and laid the foundation of the existing methods. The address abounds in references and extracts from authors of the past and is a valuable summary of the technique of a most important industry.

WE have received from Messrs. Lever Brothers, Ltd., Port Sunlight, Cheshire, samples of their new vitamin products, 'Essogen' and 'Advita.' The former is a concentration of vitamins A and D in a neutral oil, and the latter is a concentrate of higher potency put up in capsules. The oil has a bland flavour and is without any nauseous taste and smell, such as are associated with cod-liver oil. The strength of the products is controlled by animal feeding tests and also, in the case of vitamin A, by the antimony trichloride test of Carr and Price. The standards adopted are based on that given in the tenth edition of the "United States Pharmacopæia" for vitamin A, which is, that 20 mgm. of cod-liver oil should contain one 'unit,' that is, produce growth in a rat, kept on a diet deficient in vitamins A and D until growth has ceased, at the rate of 2-4 gm. a week for five weeks. The standard adopted for the normal concentrate on this basis is 20 mgm., and for the special concentrate 0.4 mgm.: thus 'Essogen' has ten times the potency required by the United States Pharmacopæia for a cod-liver oil, and 'Advita' fifty times this potency. The dose of 'Essogen' recommended is half to one teaspoonful twice a day, and of the capsules, one per diem. 'Essogen' is put up in 4, 16, and 80 oz. bottles, whilst the capsules are put up in tubes of 24.

Publicity which has recently been given to the establishment of a National Fund for Scientific Research in Belgium, and to arrangements in connexion with the Exhibition of Industry and Science to be held at Liège in 1930, has resulted in some little confusion between these two distinct undertakings. By the courtesy of M. Paul Pelseneer, the permanent secretary of the Royal Academy of Belgium, we are able to record the exact circumstances leading to the foundation of the Fund. Speaking at Seraing on Oct. 1, 1927, on the occasion of the one hundred and tenth anniversary of the establishment of the Cockerill works, H.M. the King of the Belgians referred to the important part played by 'pure' science in laying the

foundations of technical success and industrial prosperity, and deplored the penurious provision which existed in Belgium for the prosecution of study and investigation in that domain. The position was critical, and he looked to private initiative to move, and to sustain effort, in remedying the situation King Albert spoke in no uncertain terms of the serious consequences of neglect in this direction. "Le public," he declared, "ne comprend pas assez chez nous que la science pure est la condition indispensable de la science appliquée, et que le sort des nations qui négligent la science et le savant est marqué pour la décadence... Je demande à tous ceux qui forment l'élite industrielle à penser souvent à nos Universités, à nos écoles spéciales, à nos laboratories."

His Majesty's call to his subjects has not gone unheeded A gathering organised by the "Fondations Hoover pour le développement des Universités libres de Bruxelles et de Louvain," was held at the Palais des Académies, Brussels, on Nov. 27, at which the King, the Diplomatic Corps, the Ministers, and influential representatives of industry, finance, politics, and science were present. A number of delegates from the professoriate of the "Universités libres" and the "Universités de l'État" (Ghent and Liège) presented reports disclosing the difficulties, caused by the paucity of financial resources, which beset them in their scientific work. The King again declared that science, poor herself but the creator of riches, must receive assistance, or the country and her industries would be in jeopardy; that scientific men must be accorded such security and independence as would permit their entire devotion to the service of pure science He then announced the creation of a "Fonds national de la recherche scientifique," foi which a special committee would be constituted, and warmly appealed for support from industrial and financial quarters British scientific workers, to whom their Belgian colleagues' difficulties are not unfamiliar, will cordially wish the new fund all success.

THE Geological Survey of Denmark will celebrate its fortieth anniversary in June next year by a series of excursions and meetings to which foreign geologists are to be invited. Before the meeting to be held in -Copenhagen, two simultaneous four-day excursions will be arranged (June 21-24): to Bornholm, which forms part of the Baltic Shield and is of great petrological, stratigraphical, and tectonic interest; or, alternatively, to Moen and South Sixlland, where remarkable dislocations in the Senoman white chalk can be compared with the undisturbed formations. The meeting itself (June 25-28) will be devoted to lectures and discussions on the general geology of Denmark and to visits to the celebrated museums of After the meeting an eleven-day Copenhagen. excursion (June 29-July 9) will enable visiting geologists to study a wide range of glacial phenomena in north-west Sjælland, Fyn, Langeland, and Jylland. Further particulars relating to the detailed programme, accommodation, and charges will be provided in a later circular. Application for this

may be made to the Secretary of the International Meeting of Geologists, Danmarks Geologiske Undersøgelse, Gammelmønt 14, København K.

The Photographic Materials Preservation Cominittee, which was appointed by the Royal Photographic Society at the request of the Historical Section of the Committee of Imperial Defence of the Australian Commonwealth, has presented its report. The report states that "the production of records by photography has been in existence for so short a period that the Committee is not able to make any recommendations of which it can be said that their application will ensure permanence for all time. All that could be done was to select such processes and methods of treatment as were likely to give the most durable results" It is recommended that negatives and positives on glass be refixed, washed, hardened in chrome alum solution, washed, dried, and varnished with a lac varnish. Negatives and positives on celluloid should be similarly treated, but there is no suitable cold varnish for them. If invaluable, they should be copied on to glass, as both celluloid and cellulose acetate are unstable. Bromide prints should be sulphur toned Finished prints should be refixed, washed, sulphur toned, washed, hardened in chrome alum solution, washed, and dried, and mounted (if desired) by the 'dry' process on boards of the best quality. Mounted finished prints that are invaluable should be copied and the new prints treated as above All prints should be thoroughly dried and varnished by immersion in a solution of gum dammar in benzene. The storage of prints is dealt with, formulæ for the various solutions are given, and also the usual tests in solution for silver and thiosulphates. The carbon and platinum processes of printing are not referred to. It is surprising that printing in platinum, which gives such ideally simple and permanent results, has not been recommended, particularly when new prints have to be made for preservation.

THE region around the headstreams of the Indigirka and the Kolima is one of the least known regions in eastern Siberia. An expedition sent by the Russian Geological Society under S Obruchev penetrated this district in 1926, working east from Yakutsk on the Lena to Moma and Omekonsk on the Indigirka. Between lat. 65° and 66° N. the Indigurka was found to cross, in narrow valleys, a lofty range of snow-clad mountains rising to about ten thousand feet. This range is reputed to be continued eastwards to the Kolima and between the Kolima and the Omolon, and to be about 600 miles long and 180 miles wide. Its further exploration is promised in the near future. The range has been named the Cherski range, after a Russian geologist who lost his life in the Kolima region in 1892. An account of the new range by the discoverer and some photographs of it appear in the Geographical Journal for November. The northwestern end of this range is evidently the Taskhavakhtakh range, but it crosses the Indigirka in a region that was formerly considered to be a low-lying plain. Existing maps of this part of Siberia, however, are far from accurate, and it is difficult to fit the

new features on to the map until more data are available. The Cherski range appears to be built of folded Triassic strata and is roughly parallel with the great folded and faulted arc of the Verkoyansk and Kolimsk ranges.

The elimination of 'atmospherics' which sometimes seriously interfere with trans-Atlantic telephony is a problem to which the Post Office engineers have devoted a great deal of attention. Some of the partial solutions obtained are described in a paper read on Nov. 7 by Colonel A. G Lee to the radio section of the Institution of Electrical Engineers Numerous valuable experimental data have been obtained recently by Watson Watt and others. Generalising from these, the author concludes that an atmospheric is either of an aperiodic or quasi-periodic form It has a peak voltage of about 01 volt per metre and has a duration of the order of 0 003 sec. Sometimes, however, atmospherics are observed which have a fine ripple structure superposed upon the main wave form. The order of strength of an atmospheric is very considerably higher than that of any ordinary commercial radio signal Measurements of these disturbances in Scotland show that they are much smaller there than in the south of England. The noise ratio at Thurso, for example, is only about one-eighth of the ratio farther south. When considerable amplification is being used in radio telephony, owing to bad atmospherics, and electrically charged rain is falling, a loud hissing sound is heard on antenna systems. This is sometimes sufficiently strong to put the service out of action. A receiver should be designed to admit only just sufficient of the signal and its modulation products to ensure intelligibility. This is the best defence against atmospherics. Seeing that these disturbances may come to the receiving station from any point of the compass. it is a great help to employ a directive system of reception as this will be insensitive to atmospherics coming from other directions. This seems to be the only means of defence left which can be improved.

DESPITE the great increase in motor traffic in the streets of Paris and the danger of increased air pollution by dust or gases, the results of the analyses made periodically on the air of Paris at the Laboratory of Hygiene are satisfactory. The percentage of carbonic acid gas averages 30 to 45 parts in 100,000, while carbon monoxide is found only in confined spaces and in percentages varying from 5 to 6 parts per 100,000. M. Kohn-Avrest, reporting on this subject at a recent meeting of the Parıs Academy of Sciences, intends supplementing the ordinary analyses by investigations to determine what he terms the 'smoke vault.' Experiments in this direction have already been made in the gardens of the Champ de Mars and at various levels of the Eiffel Tower. Contrary to what might be expected, the air in these neighbourhoods of Paris may be regarded as very pure, being just as pure in the lower regions as in the upper. On the other hand, vitiation of the atmosphere would seem to increase with the level, either by the

presence of small quantities of carbon monoxide in the upper layers of the air, or by the appreciable increase of carbon dioxide. From these results it may be surmised that the air in the highest regions of the city can scarcely be purer than it is in the lower parts, and that there is a perceptible 'smoke vault' at slightly below 1000 feet. For this reason M Kohn-Avrest is in favour of increasing squares and open places and keeping buildings at a reasonable height.

MR E. F. STEVENS, librarian of the Pratt Institute Free Library, Brooklyn, New York, has favoured us with a copy of a useful annotated list of "Technical Books of 1925" compiled by Mr Donald Hendry, head of the applied science reference department of the library This additional guide to selected scientific and technical books supplements the sources of information referred to by Sır Rıchard Gregory ın the paper on "Standards of Book Selection in Science and Technology" published in Nature of Oct 8. Mr. Stevens informs us that an annual list of technical books has been issued by the applied science reference department of the Pratt Institute Free Library for eighteen years. The annotations are made with great care, and the books are designated by symbols as to their character and scope. The list is distributed free upon request to libraries in many parts of the world; and although it is limited to about one hundred books and cannot therefore be a complete guide for comprehensive libraries in science and technology, it should be of decided value to libraries in general.

"THE Industrial Transition in Japan" is the title of a pamphlet by Mr. M. Holland, published jointly by the National Research Council of the United States and the Japan Society. Japan is to-day distinguished by the liberal official support given to scientific research, and the generous subsidy provided by the government for national research institutes in every branch of industry. There is, on the other hand, little interest in research on the part of industrial organisations, and few private research laboratories in industry exist. Mr. Holland believes that the stimulus to research is hindered by the large number of research workers who have received their scientific training in Germany, Britain, and France, and their consequent dependence on foreign methods, technique, and instruments, and even their preference to publish their results in languages and journals foreign to Japan. In spite of these drawbacks, modern scientific methods have had striking results during the half century that they have been practised in Japan. The booklet contains an interesting outline of artificial pearl culture, and some other aspects of fisheries technology.

The wild life of Spitsbergen has suffered much during the last hundred years from trappers, hunters, and sportsmen. Reindeer, foxes, and walrus, which were once numerous, are now rarely seen in the more accessible parts. One of Norway's first concerns on taking over the sovereignty of Spitsbergen has been to protect the wild life from further destruction. Petermanns Mitteilungen, 1927, Heft 9/10, contains a

summary of the measures that have been proposed. Reindeer are entirely protected until 1934. After that date it is hoped that the stock will have increased enough to allow hunters to take 250 head a year. The Arctic fox, which is the staple of the Norwegian trappers, is not to be taken between April and October, when they are valueless for fur. There seems to be no means of protecting the polar bear, since it is really a sea mammal, and is generally shot on the ice on the high seas. The walrus are protected for ten years No measures are to be taken with regard to other seals and whales. A close season is proposed for the shooting of geese, from July 15 to Aug. 15, and for the collection of the eggs and down of eider ducks. It is further proposed to set apart as reserves for game two national parks, in which all hunting is to be prohibited. The largest is to be in the north-west. and to include about five thousand square miles north of Ice Fjord and west of Dickson and Wijde Bays. The second is to be the small Bear Island, with an area of about seventy square miles.

A serious difficulty in connexion with electric ploughing is the dragging over the ground of the flexible electric cable connecting the tractor plough to the dynamo. A novel method has recently been tried experimentally in Italy of getting over this difficulty. A balloon is used to suspend the connecting cable in the air. An insulated aluminium cable was used. The diameter of the balloon was 17 feet, and its net lifting power was 110 lb. The tractor travelled at a speed of 21 miles per hour and ploughed to a depth of from 12 to 18 inches. The height of the balloon depends on the position of the tractor. As a precaution a steel safety cable is attached to the balloon. This is a novel development of the ancient art of ploughing. In a paper read to the Institution of Electrical Engineers by Mr. Borlase Matthews on Dec. 1, he pointed out that to solve the present farming crisis, agriculture will have to be industrialised by the aid of electric power. He described his experiences of electric ploughs. more than two hundred of which are now in use abroad. Some of the ploughs he described are only suitable for large areas and co-operative or contractor ownership, as they plough from 12 to 30 acres per day. He also describes smaller ploughs suitable for individual small farmers and market A very interesting development in electric ploughing is the action of the electricity supply undertakings who are distributing current in the agricultural area some 30 miles round Paris. They have formed a separate company and a number of operating centres Any farmer in this area can have the use of electric ploughs at the lowest commercial rates. Work can be carried on at night, and once the ploughing season starts there are no stops for Sundays or holidays. An electric plough can make a very deep furrow and can be usefully operated for 200 days in the year.

The sum of £100 is being offered by the Royal Society for the Protection of Birds for an invention of a portable apparatus for the detection of small

quantities of carbon monoxide in mines, to supersede the use of canaries and small wild birds now forming part of the equipment of rescue brigades. Full particulars may be obtained from the Secretary of the Society, 82 Victoria Street, S.W 1. All competing essays should be received by Mar. 31 next.

It is announced in Science that the John Fritz gold medal for 1928 has been awarded to General John J. Carty, of New York, for achievement in telephone engineering. This medal is awarded annually by a board representing the American Societies of Civil, Mining, and Metallurgical, Mechanical, and Electrical Engineers, for notable scientific or industrial achievement, without restriction on account of nationality or sex. This is the twenty-fourth award which has been made. The presentation of the medal will take place in February next in connexion with the annual meeting in New York of the American Institute of Electrical Engineers.

It is announced in a recent Daily Science News Bulletin (No 346 D), issued by Science Service, Washington, that Drs. Leonard and Feirer, of the Johns Hopkins School of Hygiene, have succeeded in utilising hexviresorcinol as a general antiseptic. This substance has been used as an internal antiseptic, but apparently a proper solvent for it was not known, so that it could not be used as a disinfectant solution. It is now stated that an aqueous solution of glycerin (strength not stated) accomplishes this, and that the solution is very potent in killing bacteria, while having little deleterious effect upon the tissues of the body.

WE have received the annual report of Livingstone College, Leyton, for the year 1926–27. The past year has seen the largest entry of students since the College started, and the financial position has therefore improved, though an accumulated deficit of £883 still exists. Donations and subscriptions are needed to help the work of the College, which is to give missionaries instruction in the preservation of health and treatment of disease.

A REPORT by Dr. H. M. Ayres to the Monmouthshire County Council appears in the October issue of *The Fight against Disease*, the journal of the Research Defence Society, on the vaccinal condition of the first 1230 cases of smallpox which occurred in that county between February and July 1927. Not a single case of the disease occurred in a child who had been successfully vaccinated before the epidemic, while among the unvaccinated school children of less than 15 years, there were not less than 355 cases.

Prof Archibald Liversidge, emeritus professor of chemistry in the University of Sydney, who died on Sept. 26 last, leaving estate of the value of £46,000, bequeathed to the University of Sydney two sums of money, £2000 and £500, towards a scholarship and for the advancement of science in Sydney respectively. Other bequests include £1000 and £500 to Christ's College, Cambridge, towards a scholarship and a research lectureship in chemistry respectively; £1000 to the Royal School of Mines, towards a scholarship; £500 each to the Royal

Society of New South Wales and to the Australasian Association, and also to the Chemical Society of London, towards research lectureships in chemistry, as well as a further £100 and his unpublished papers on scientific and chemical matters.—Another recent benefaction, which appears in the will of Mrs. Marryat, sister and heiress of the late Sir James Caird, is a bequest of £200,000 for the foundation of travelling scholarships in engineering, electricity, aeronautics, and music, to be eligible to natives of Scotland only, to be known as 'Sir James Caird's Travelling Scholarships.'

THE Juvenile Christmas Lectures at the Royal Institution will be delivered by Prof. E. N. da C. Andrade on "Engines," commencing on Thursday, Dec 29. The general courses of lectures before Easter will begin on Tuesday, Jan. 17, at 5.15, when Mr. P R. Coursey will deliver the first of two lectures on the development of dielectrics for electrical condensers. On succeeding Tuesday afternoons there will be three lectures by Dr. A. P. Newton on (1) the Mercantile Empire, 1606-1783; (2) the settlement of the Dominions, 1783-1870; (3) the Dependent Empire and the British Commonwealth of Nations, 1870-1926; and six lectures by Prof. Julian S. Huxley on the behaviour of animals On Thursday afternoons at the same hour there will be three lectures by Sir William Bragg on Faraday's notebooks; two by Dr F. Ll. Griffiths on Nubia in antiquity and in the Middle Ages; two by Dr. J. J. Fox on optics and chemistry; and two by Group Capt. M. Flack on the physiological aspects of flying. Sir Ernest Rutherford will deliver four lectures on the transformation of matter on Saturday afternoons at three o'clock. The Friday evening meetings will commence on Jan. 20, when the discourse will be delivered by Sir William Bragg on photo-electricity. Succeeding discourses will probably be given by Miss D. A. E. Garrod, Prof. E. C. C. Baly, Prof. B. Melvill Jones, Rev. E. M. Walker, Sir Farquhar Buzzard, Prof. E. A. Milne, Sir Ernest Rutherford, and others.

Under the energetic leadership of Prof. H. Arctowski, formerly working in the United States, the Institute of Geophysics and Meteorology of the University of Lwow, Poland, has become an active centre of theoretical studies in meteorology. The second volume of Communications, just issued, contains twelve papers by Prof. Arctowski and his collaborators. They are written in Polish, but with summaries in French. The subjects dealt with include the variations of temperature in North America, Japan, China, and Indo-China during 1910–1919; the large-scale transport of mass in the atmosphere; perturbations of atmospheric transparency; and the daily variation of the barometric pressure at Batavia and Manila.

A FULL and useful catalogue of books relating to the East has reached us from the Librairie d'Amérique et d'Orient Adrien-Maisonneuve, 5 Rue de Tournon, Paris (VI°). The works offered for sale are carefully classified under the countries with which they deal. The prices asked are given in French francs.

A NEW part of the well-known "Catalogue of Science and Technology," No. III., of Messrs. H Sotheran and Co, 140 Strand, W.C.2, has just been issued. Its designation is No. 806, Part VIII., including XII., and is devoted to works on mining and metallurgy. As usual with this publication, it is a mine of bibliographical information and should certainly be seen by those interested in the subjects dealt with.

WE have received from Messrs C Baker, 244 High Holborn, W C 1, their classified list (No. 91) of second-hand scientific instruments. Microscopes and microscopic apparatus, particularly objectives and eyepieces, occupy 20 pages of the list and offer a considerable range of first-rate instruments and accessories. Astronomical and other telescopes and field-glasses, spectroscopes, theodolites, and other surveying and drawing instruments, meteorological and ophthalmic instruments, and sundry electrical and other apparatus, are also catalogued. A supplementary list contains the large collection of scientific and photographic apparatus and engineering equipment, the property of the late Mr Edward Sanger Shepherd, which Messrs. Baker have for disposal.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A patho-

logist at the Infants' Hospital, Westminster-The Secretary, Infants' Hospital, Vincent Square, Westminster, S.W.1 (Dec 31). A lecturer in chemistry in the University of Durham (Durham Division)—The Head of the Department of Science, South Road, Durham (Jan. 2). A research assistant in the testing department of the British Cotton Industry Research Association—The Secretary, British Cotton Industry Research Association, Shirley Institute, Didsbury, Manchester (Jan 4). A part-time principal of the L.C.C Clapham School of Art, 6 Edgeley Road, Clapham, SW.4—The Education Officer (Tla), The County Hall, Westminster Bridge, S.E 1 (Jan. 7). A principal of the Technological Institute, Cawipore —The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, SW.1 (Jan. 15) A professor of chemical engineering at University College—The Academic Registrar, University of London, South Kensington, S W 7 (Jan 23). Two junior assistants under the Linen Industry Research. Association, one with qualifications in physical chemistry and the other in engineering and with some knowledge of chemistry and physics—The Secretary, Linen Industry Research Association, Research Institute, Lambeg, Co. Antrim. A junior assistant chemist for a Government laboratory—The Commandant, Experimental Station, Porton, Wilts.

#### Our Astronomical Column.

Skjellerup's Comet.—Another observation of this comet was obtained by Mr. Maristany at La Plata on Dec. 6d 0h 36m U.T. , R A. 16h 27m; S. Decl 50° 0′; magnitude 2. The object was only  $2\frac{1}{2}$ ° above the horizon.

The following elements were calculated by Mr H. E. Wood (Union Observatory, Johannesburg) and have been telegraphed from the I.A.U.

T 1927 Dec. 1·192 U.T.  

$$\begin{array}{cccc}
\omega & 323^{\circ} & 29'\\
\Omega & 79 & 20\\
i & 72 & 10
\end{array}$$
 1927·0  
 $\begin{array}{cccc}
i & 72 & 10
\end{array}$ 

Ephemens for 0h:

	R.A		Decl		log _	
Dec. 18.	18h 11m	20s	5° 2′	$\mathbf{s}$	9.47	
22.	18 39	44	14 8	$\mathbf{N}$	9.5223	
26.	19 0	58	27 57	N	9 5980	
30.	19 22	51	36.52	N	9.6799	

The comet should become visible in England in the west after sunset about Dec. 20. Its altitude will rapidly increase, but its distance both from sun and earth will increase fairly rapidly, so that it is unlikely to be conspicuous for long.

The values of  $\Omega$ , i, q, are fairly near those of De Vico's comet, but  $\omega$  is 50° smaller, which is too great a difference for identity to be possible.

The Rotation of the Galaxy.—Dr. Oort returns to this question in Bull. Astron. Instit. Netherlands, No. 133. He introduces some faint distant Cepheids to add weight to his determination. They give  $320^{\circ}\pm7^{\circ}$  for the longitude of the centre, agreeing well with the value  $324^{\circ}$  obtained from eight other groups of stars. He considers that his results give an indirect confirmation to the validity of Shapley's parallaxes of distant Cepheids.

Dr. Oort notes that it is possible to explain the motions with a smaller central condensation of mass

than that given in the previous paper. He now gives the density in the inner ellipsoid (the axial ratios of which are 10 to 1) as 0.66 of the sun's mass per cubic parsec, while in the shell outside this it falls to 0.30 of the sun's mass. These values involve the assumption either that there are many stars too faint to see or that there is a large proportion of non-stellar material in the galaxy.

Occultations — Union Observatory Circular No. 72 contains a careful discussion by Dr. Innes of 90 occultations of stars by the moon observed at Johannesburg in 1926 In the mean the correction to Brown's longitude of the moon is +7''3. The error has only varied very slightly since the introduction of Brown's tables in 1923 Dr. Innes gives the error as wholly one of time (due to variable rotation of the earth), it seems inadvisable to put the whole of it down to this source. Prof. Brown now admits that the secular acceleration of the moon is some 4" greater than the term used in his tables, this involves consequential changes in the longitude at epoch and mean motion; also there is a small correction to his longitude of perigee. Only the residue after making these corrections should be ascubed to variable rotation of the earth.

The circular also contains some observations of phenomena of Jupiter's satellites, and the deduction of time-errors from them. The mean error for the last four years is  $-43^{\rm s}$  7 for satellite I, and  $-45^{\rm s}$ ·8 for II.; these errors have increased greatly for both satellites since 1909, but seem now to have reached a maximum.

There are also some interesting observations of mutual eclipses by the shadows of other satellites, and comparison of these with the predictions in the B A.A. Handbook for 1926. On June 29, 1926, an unusually dark transit of IV. was observed, and on Aug 15, 1926, the date of opposition, I was seen on the disc partially covering its shadow.

## Research Items.

STRING FIGURES IN OCEANIA.—Mr J. Hornell has published as Bulletin 39 of the Bernice P. Bishop Museum of Honolulu, a record of string figures collected in Figure and in the Marquesas, the Society Islands, and Samoa and Tonga. Although these figures had not hitherto been recorded in Samoa, it is probable that further research would produce numerous examples Tonga proved a rich field for study, but the largest number, 58, was obtained from Fiji. Most Fijian figures are named after the object they are supposed to represent, the owl, the caterpillar, the butterfly, and so on; others represent trees or the leaves of the pandanus. In a few the Fijians see a resemblance to the sun and his rays, and one is named "The Star." The figures showed no mythological significance, but this may have been lost under missionary influence A large number were originally worked to the accompaniment of a chant, some of which must have been of great antiquity, as the significance of the words has been lost. The geographical distribution of the figures suggests certain ethnological affinities Of these the most striking is the predominance of Melanesian influence in Fiji. Of 30 figures and series of figures, 12 occur in New Caledonia, Torres Straits, Fly River, New Gunea, Loyalty Islands, and D'Entrecasteaux Next in importance is relationship with Tonga, 7 figures being in common. Six of the Fijian games are Polynesian, being found in the Marquesas and Society Islands. Of these one is the most widely spread of any string game in Oceania The Toi games are wholly Polynesian if Fiji be excluded. The Tongan

Marine Biology at Millport.—The annual report for 1926-27 of the Scottish Marine Biological Association shows that a large amount of work has been done both by the staff and by the visitors. The valuable researches on plankton undertaken by the hydrographer, Mr. A. P. Orı, and the assistant naturalist, Miss S. M. Marshall, are still progressing. Following the work on Loch Striven, begun in 1926, now complete and published in the Journal of the Marine Biological Association, various experiments were made on the biology of diatoms, and these are still in progress. It was found that direct sunlight was injurious, specimens from five fathoms and more appearing much healthier than those from the surface, and diatom cultures grow best in the shade. A comparison of the amount of sunlight and diatom maxima extending over a period of three years shows that, unlike the results from Plymouth and Port Erin, the latest diatom maximum actually corresponded with the year which had most early sunshine. It is suggested that a measurement of the total amount of incident light, and not of sunshine alone, would be a more trustworthy guide. Mr. R. Macdonald, Carnegie Research Student, in continuing his work on the Euphausudæ, has completed the life-history of Thysanassa Raschii which is very abundant in the district. A survey of the sandy bays of Cumbrae by the superintendent, Mr. R. Elmhirst, and Mr. A. C. Stephen, with special reference to the biology of Tellina tenuis, begun only recently, should yield interesting and important results. This molluse is exceedingly common in Kames Bay, the numbers sometimes reaching more than seven thousand per square metre in one station.

BIOLOGICAL INVESTIGATIONS IN THE BLACK SEA.— The Sevastopol Biological Station of the Russian Academy of Sciences (according to the *Information Bulletin* of the Academy, No. 20, 1927) carried out

during the last summer a series of investigations in the Black Sea. A study of distribution of animal life was undertaken during two expeditions, one along the Crimean shores, while another covered a large area m the eastern portion of the sea It was found that the fauna near the shores of the Caucasus and Anatolia is considerably poorer than that near the Crimean shores. The lower limit of benthos has been found not to drop below 140-160 metres, while in some parts it is still nearer to the surface. The lower limit of plankton proved to be also not deeper than 150-170 metres, and in some places in the central part of the sea it has been found only 90-100 metres deep; in all cases the vertical distribution of plankton proved to be directly connected with the distribution of oxygen and of hydrogen sulphide in the water. Hydro-chemical work included also determinations of carbon dioxide in the water, for the first time in the Black Sea, and it has been found that the quantity increases with the depth, and reaches a very high absolute figure

THE HELIA BIP.IRTIT.1 OF AUSTRALIA.—The conspicuous Helix bipartita of Pfeiffer, hailing from north-eastern Australia and its neighbouring islands, and now placed in the genus Thersites, section Hadra, with all its innumerable varieties of form and size, has long been well known to collectors, who have been content to refer them to one, or at most four species. Now, however, a large collection has been presented to the United States National Museum, and Mr W. B Marshall, having arranged them in geographical sequence, considers that many characteristics are thereby revealed, showing that specialisation has taken place along certain definite lines and that the recognition of additional species and sub-species is necessary (Proc. U.S Nat. Mus., vol 72, art. 15). His list now contains twenty-seven names, including T. darwini, which he has not seen Four of these are given as new species, and the bulk are new 'sub-species' which may or may not prove valid. Since the author has adopted the method of late employed by certain zoological writers, more especially ornithologists, of stringing the sub-specific name on to that of the species, his nomenclature is for the most part quadrinominal instead of binominal. His paper, however, will have to be seriously reckoned with by anyone taking up the group.

JAPANESE JELLY-FISHES.—The Anthomedusæ of Japan are many and varied and a number of beautiful and interesting forms are described by Dr Tohru Uchida ("Studies on Japanese Hydromedusæ. I. Anthomedusæ." Journal of the Faculty of Science. Imperial University of Tokyo. Section 4. Zoology, vol. 1, Part 3, 1927). Not only is the morphology of all forms carefully worked out and a satisfactory classification arrived at, but also the life-histories are studied whenever possible, and very important additions are made to our knowledge of the metamorphoses in this group. The author bases his systematic work mainly on the structure of the canals, tentacles, manubrium, and gonads, regarding the oral tentacles and ocelli as of only secondary significance. An account of the early development of  $\bar{S}pirocodon$ saltatrix is given, showing that spawning always takes place after sunset in natural conditions, but if brought into a dark room the medusa will lay eggs in half an hour to an hour, so that these are easily obtained for study. The hydroid is not known, but the development from the very young medusa is described, showing a wonderful series of changes beginning from a simple Sarsia-like form and passing through phases

corresponding with the Tiaridæ and Nemopsis until the final adult Spirocodon is reached. The principal changes are the appearance of numerous side branches from the radial canals, four arborescent canals from each inter-radius, the multiplication of the marginal tentacles, complication of the manubrium by frilling of the lips, development of the gonads, which form spirals in the radial canals, and the formation of a central cone of jelly. Good reasons are given for relegating Spirocodon saltatrix to the Anthomedusæ together with Polyorchis and Scrippsia instead of to the Leptomedusæ where they were formerly placed on account of the position of the gonads

Tertiary Mollusca of Japan Prof. M. Yokoyama contributes (Jour. Fac Sci Imp. Univ Tokyo, Sect 2, vol 2) three more papers on the Tertiary Mollusca of Japan From the province of Kaga, about the middle of the northern side of the principal island, a series of some 120 species of mollusca was obtained referable to the Musashino, or Phocene, and the more important species are described and figured As before, the author finds that the sea of central Japan was somewhat cooler then than at present. From Western Hizen, in the neighbourhood of Nagasaki, a few fossils, including fourteen mollusca, mostly badly preserved and of Phocene age, have been procured and form the subject of the second paper. The third paper describes those mollusca found in the Chikbets (Phocene) and Haboro (Miocene) beds in the coalfields of Haboro, Province of Teshio, at the northern end of the Island of Yezo. Some thirty-three species are described and figured.

LIGHT REFLECTION FROM LEAVES.—Prof. Chas. A. Shull, of Chicago, gave some interesting details regarding the reflecting power of leaves at a recent meeting of the National Academy of Sciences held at Washington. A report of the paper has been issued by Science Service, of Washington. Prof. Shull finds that different leaves reflect different proportions of the incident light, and the same leaf reflects light of different colours in different percentages. Thus the upper surface of a silver poplar leaf reflects 7.5 per cent. of one of the violet hues, and 20 per cent. of the light in the green-yellow part of the spectrum. The upper and lower surfaces of the same leaf have different reflecting powers The silver poplar leaf, which is dark green above but shining white beneath, reflects 85 per cent. of the deepest red rays from its upper surface and 50 per cent. of the same rays from its under surface. Autumn coloration of leaves also influences their reflecting power. Red leaves of woodbine reflect nearly twice as much red light as they do of violet; but their total reflection is far less than that of bright yellow birch leaves, which reflect more than 40 per cent. of the incident light, as against 13 per cent. for woodbine.

Timber Seasoning.—Timber in various forms is in such universal use that the importance of its proper seasoning before manufacture and utilisation is beyond dispute. With the imcreasing demands made upon the world's timber resources and the diminishing supplies, any factor which will assist in prolonging the durability of wood, and therefore its longevity when manufactured, will lessen in some degree the calls upon the forests. Seasoning is well understood by many persons in the timber trade. The practical disappearance of all stores of seasoned timber in Great Britain during the progress of the War has, however, disclosed the fact that a considerable section of those interested in timber and its seasoning are not so knowledgable. The new Forest

Products Research Laboratory at Princes Risborough has recently issued a report by Major F M Oliphant on "The Air Seasoning and Conditioning of Timber" (Special Report No. 1). The report does not pretend to deal with new facts. Its author has had two objects in view: first, to discuss the fundamental factors governing the process of drying timber, and secondly, to illustrate methods by which such factors can be utilised to season it to the best advantage. The structure of wood and its moisture contents, weather aspects, especially as regards moisture, are first dealt with, followed by sections treating of defects caused by air-seasoning, and various methods of piling timber in stacks for air-seasoning, the report is illustrated, the photographs of stacking methods being particularly useful

INHERITANCE IN MORNING GLORIES —In a genetical investigation of Pharbitis purpurea, which is closely related to the Japanese morning glory, P Nil, Mr Yoshitaka Imai (Jour Coll Agric, Imp Univ Tokyo, vol 9, No. 3) records certain interesting genetic differences from the latter species The heterozygous condition of flower colour is intermediate in P. pur-purea but dominant in P. Nil There is an intensifying factor for red colour, which shows its effect in corolla and stem and also in changing the seed from tan to black, absence of the red factor producing white flower and green stem. Another factor causes extension of colour in the corolla, and here again the heterozygous condition is intermediate factor may also be present, but its effect can only be detected in the presence of the extension factor. feathered double type of flower occurs, similar to that of the other species, but it produces good seeds, whereas the double  $P.\ Nil$  is sterile. It behaves as a simple dominant in crosses, and there appears to be a low degree of linkage between doubleness and flower colour. More recent results by Prof K. Mıyake and Dr. Imai (Jour. of Genetics, vol 19, No. 1) show that in P Nil the common petaloid double is recessive to single flower. Many forms of doubling are found to exist in this species and they have been analysed genetically, so that the breeders' difficulties in perpetuating their stocks can now be overcome four main types of doubling, some of which can be combined by crossing In petaloid forms the pistil is fertile and the petaloidy commonly occurs on the anthers, but may refer to the filaments In the 'Shishi' type the corolla tube is broken up into narrow lobes which take various forms, and the sex organs are more or less deformed. The 'Botan' type has no stamens or pistil, and the corolla tube contains additional flower buds All these and other monstrous types, which are much admired by the fanciers, are shown to be determined by a series of genetic factors. The original doubles were introduced from China over a thousand years ago.

Surveying from Air Photographs —In 1926 the Ordnance Survey experimented in air surveys in an area of 20 square miles near Arundel. The result was encouraging both as regards the speed with which the work was done and the standard of accuracy achieved Moreover, the total cost was found to be reasonable, though the cost of air photography is high. On the other hand, the expense of aerial survey would not increase on difficult ground where the expenses of the usual form of survey would rapidly mount. In such areas, therefore, the air method would be the most economical. The detailed procedure of the Arundel Survey, with an account of the instrumental output, is given in a paper entitled "Simple Methods of Surveying from Air Photographs," by Lieut. M. Hotine

(Professional Papers of the Air Survey Committee, No. 3. London · H.M Stationery Office) The paper contains a chapter on the making of controlled mosaics. There is also a specimen 6-inch drawing on transparent paper with the usual Ordnance Survey on one side and the aerial survey on the other.

THE ENERGY OF CYCLONES.—The problem handled by V. H. Ryd, in Meteorological Problems (2), "The energy of the winds" (Publikationer fra det Danske Meteorologiske Institut, Meddelelser Nr 7, pp. v+96, Kjobenhavn, G E. C Gad, 1927), is the fundamental one of the source of the energy developed in cyclones and anticyclones After a careful examination of some simple cases in which the conditions can be worked out and definite conclusions reached, the author considers Margules' theories as stated in Exner's "Dynamische Meteorologie." He concludes that only a small part of the energy of a cyclone is to be found in the horizontal pressure field, and that if this field was expended, the kinetic energy generated would only be a small fraction, say 1/100, of its energy; the pressure field is rather to be looked upon as "the means whereby energy is transported from the atmosphere to the inner part of the depression "Margules' example of the energy available from the juxtaposition of masses of air at different temperatures is criticised on the ground that in Nature, where we have no partition walls, most of the potential energy would be spent in vertical velocities, ending in turbulence and heat; and this conclusion is in agreement with Hesselberg's results. This destructive criticism calls for something constructive, and Ryd produces a theory that the energy of cyclone formation comes from the west-easterly motion of the upper air. Here a locally strong wind will be deflected to the south and will produce a small area of low pressure, the effect of which is by some means transmitted downwards advantages claimed for this theory are that it accounts for the escape of the air that ascends in a cyclone, and for Hesselberg's law that the direction of cyclone motion is that of the cirrus cloud.

Insulating Materials for Telephone Switch-BOARDS —The problems which the designers of telephone switchboards have solved are appreciated by few. In one type of switchboard, there are 31,000 contacts, all insulated from one another, in an area five feet wide and two and a half feet high. electric leakage on the surface and sometimes also through the material of the insulator itself often causes trouble. In damp weather the insulation resistance is often only a small fraction of what it is in dry weather For telephone work, only insulating materials which are little affected by moisture can be used. Hence hard rubber, phenol fibre, and vulcanised fibre are widely used. Hard rubber in particular is an excellent insulator, but when subjected to long continued stresses it yields This yielding is generally known as cold flow,' the hard rubber acting like an exceedingly viscous liquid. Another limitation to the use of hard rubber is its rapid deterioration when exposed to light. These two objections to the use of hard rubber have led to extensive researches to discover a better material. Various kinds of phenol fibre are found to maintain their insulation resistance much more satisfactorily than hard rubber, and these are put on the market under various trade names. Vulcanised fibre is also extensively used. In the October number of the  $Bell\ Laboratories\ Record,\ J\ M.$  Wilson discusses the properties of sheet insulating materials. Many new varieties of these materials are tested in the Bell laboratories, and records are kept of the difference between their properties and those of the existing materials for which they are proposed as substitutes.

THE SPECTRA OF SCANDIUM.—The analysis of the are and spark spectra of scandium is described by H N. Russell and W F Meggers in a paper (No. 558) from the U.S. Bureau of Standards These are of special interest from the fact that they come from the lightest element which possesses the complicated spectra of the type associated with the heavier metals. Some five hundred lines in all have been referred to spectral terms, leaving only a few scattered lines of feeble intensity unclassified. Almost all of the terms have been identified with definite atomic configurations, and it has thus been possible to find the beginnings of a number of series which lead to consistent determinations of the ionisation potentials. From the data obtained in this way, it has been shown that the energy required to ionise the neutral atom is 6 65 electron-volts, whereas from comparative observations of furnace spectra it should be between the values for calcium (6 l volts) and titanium (6.8 volts), whilst equally good agreement is obtained between the second ionisation potential of 128 volts predicted from these spectra, and a value of 125 volts which has been derived from the conditions of appearance of ionised scandium in stars.

THE CATALYTIC SYNTHESIS OF WATER VAPOUR IN CONTACT WITH METALLIC GOLD. The October number of the Journal of the American Chemical Society contains an account by A. F. Benton and J. C. Elgin of an investigation of the union of hydrogen and oxygen in the presence of a reduced gold catalyst between 130° and 150° C. Measurements of the reaction kinetics and the adsorptions of the two gases were made, but no satisfactory mechanism for the reaction could be deduced from the observed results. In spite of the similarities in their chemical properties and adsorption phenomena, gold and silver appear to bring about the catalytic synthesis of water vapour in quite different ways. It was found that the rate of reaction with a gold catalyst is dependent upon the oxygen pressure and the square of the hydrogen pressure, whereas Bone and Wheeler found that it was independent of the oxygen pressure. Benton and Elgin suggest that this apparent discrepancy may be due to the higher temperatures used by Bone and Wheeler.

THE DIELECTRIC CONSTANTS OF BINARY MIXTURES. Two papers on this subject by Kirchma and Williams, and Williams and Allgeier, appeared in the Journal of the American Chemical Society for October. The first paper contains dielectric constant and density measurements for solutions of benzene, toluene, chloroform, ethyl ether, methyl and ethyl acetates, acetone and ethyl and iso amyl alcohols in carbon tetrachloride. The dielectric constants were determined by an electrical resonance method or by a new 'bridge' method. The electric moments of the molecules of the dissolved substance were calculated, and it was found that the moment of the benzene molecule is practically zero. It was also observed that the electric moments of organic molecules tend to increase as the length of the carbon chain increases. This is in accordance with the results of previous workers. The second paper contains similar measurements for benzene solutions of benzoic acid, phenol, iodine, stannic iodide, antimony tri-iodide, and silver perchlorate, and the values obtained for the electric moments are discussed in relation to atomic structure and solubility. The value for iodine is considered in some detail, since if the iodine molecule is symmetrical, its moment should be zero, and attention is directed to the explanation advanced by Lewis, who has shown that a symmetrical molecule such as iodine may become polarised and consequently have an electric moment.

## Dutch Pendulum Observations in the Atlantic, the Pacific, and the Indian Oceans.

AN account of the first part of Dr Vening Meinesz's voyage on board HM. Submaine KXIII from Helder to Honolulu through the Panama Canal was published in NATURE of Dec. 25, 1926. I propose now to give some particulars about the voyages from Honolulu to Surabaya and to the Java Deep.

In my first communication I mentioned that the number of observations between Honolulu was 32;

there were further ·

Manila—Amboma, Nov 20-Nov. 25		6
Amboma—Banda, Nov 25		1
Banda—Bima, Dec 2-Dec 6		8
Bima—Surabaya, Dec 7-Dec 13		1

The number of observations at sea during the whole voyage is 113, 2 of which were made at the surface of the sea: in the Atlantic, the Philippines, the Straits of Manipa (Moluccas), and the Java Sea. Through a misunderstanding I mentioned in my first communication that the observation in the Atlantic was a failure.

Several observations were made on the same day:

<b>2</b>	observations		. 10	times
3	,,		. 4	,,
4	,,		. 2	,,

Double observations at sea were made 5 times, 3 of which sailing east and west (Eotvos-effect) and 2 with the freezing apparatus working and idle.

The number of observations in the harbours was 15, all were double, with free hanging apparatus and with fastened gimbals.

The time signals used were those of Lembang, Java, given by the radio station of Malabar. Between Honolulu and Manila the signals of Saigon were also audible, and after leaving Manila those of Bordeaux.

Because of the high temperature the films were no longer developed on board, but whenever a harbour was reached development took place. In the long run the quality of the films became less satisfactory; but though the records were not so perfect as might have been, they were still efficient.

The crossing from Honolulu to Guam in nineteen days was exceedingly trying, the temperature of the sea-water being 30° or 31° C. Owing to a leakage, the freezing machine lost all its methyl chloride and remained out of action for the rest of the voyage, as no supply could be made in any of the harbours at which the submarine called

From Guam so far as the Straits of Surigao the weather was very rough, but happily the ship was in the rear of the typhoon which had swept over part of

the Philippines just before its arrival.

The crew met a friendly reception at Guam, Yap, and Manila. On the arrival in the Dutch harbours Amboina, Banda, and Bima they were splendidly received by the authorities and by the population. From Banda the ship did not sail straight to Bima, but in order to make observations it went first in a southern direction so far as the Sahul shoal on the shelf of the Australian continent. In this manner the curved double range of islands on the border of the Banda Sea was crossed twice.

Banda Sea was crossed twice.

On Dec. 13 the ship arrived at Surabaya after a voyage of 200 days, 112 of which had been sailing days. The length of the whole track is 20,600 miles. Never before has so long a voyage been performed by an unescorted submarine. The crew arrived in good health notwithstanding the hardships of so long a stay on board the small vessel, which measured but 800 tons and offered very poor accommodation. The ship and the engines, built at the yard 'Feyenoord' at

Rotterdam, were during the whole voyage in the most perfect condition

Vice-Admiral A F. Goossens, Commander of the Fleet and Chief of the Navy Department at Batavia, was present to welcome the crew, and informed Commander van der Kun and Dr Vening Meinesz that H M the Queen had been pleased to make both of them officers in the Order of Oranje-Nassau, whilst many among the officers and the crew received other marks of distinction. The first days at Surabaya

brought a series of festivities.

After having made one more observation in the harbour of Surabaya, Dr. Vening Meinesz was able to go to the mountains for a well-deserved rest. But again and again this rest was interrupted by his giving lectures in the principal towns of Java about his voyage.

On meeting the admiral at Surabaya, Dr. Vening Meinesz had availed himself of the opportunity to request if before his return to Holland H.M. Submarine K XIII could once more be placed at his disposal for the making of pendulum observations in the deep south of Java This request was granted directly; so, on Feb. 3 he again embarked at Surabaya and sailed through the Straits of Bali into the Indian Ocean. The observations were made in four profiles perpendicular to the Java Deep; they are twenty-six in number, and will give a complete record of the gravity in this part of the ocean. The results have not yet been computed

The submarine sailed through the Straits of Sunda to Batavia, where Dr. Vening Memesz disembarked on Feb. 14. He left Java on Mar. 9 on board a mail steamer, and arrived at Amsterdam on April 9. At the meeting of the Amsterdam Academy of Sciences on June 25 he read a paper upon the provisional results of his observations and the conclusions which, with some reservation, may be drawn from them. These conclusions are principally the following:

1. In the Atlantic and the Pacific there are excesses of gravity extending over large areas. As has been explained by Dr. W. Bowie and C. H. Swick, both of the U.S. Coast and Geodetic Survey, these may be caused partially by a depression of the geoid with regard to the spheroid. The final computations will show in how far this circumstance may account for the excesses.

2. It is unlikely that the longitude terms introduced by Helmert and by Heiskanen in the formulæ will agree with the values of gravity obtained in the oceans

3. In the Pacific there exists a remarkable parallelism between the variations of the anomalies and of the sea-depths.

4. The observations made above the four deeps all show a remarkable defect of gravity in the middle of the deep. The excesses on the borders do not make the impression that they may be ascribed to an excess of mass below the deeps, required for isostatic compensation, but give rise to the supposition of tangential pressure in the earth's crust.

5. The observations at the feet of the continental slopes give greater values of the gravity than should be the case according to the current theory.

6. The results obtained in the Banda Sea, especially near the double range of islands, show a large excess at the inside; that gradually changes into a very noticeable defect at the outside, where the tangential pressures which are probable in this part of the archipelago should make an excess probable. The great anomalies are in accordance with the general view that in this part of the world the earth-crust was recently, or is still at present, in a labile condition.

7. In general, the results obtained at sea give the impression of greater regularity than those obtained on land. This agrees with what was expected. The outer layer of water immediately below the observer is homogeneous and the disturbing masses in the solid crust are farther away. Moreover, the deformation caused by erosion is absent

The list of the provisional results of Dr. Vening Memesz's o'vservations in the Atlantic and the Pacific is published in the *Proceedings of the Amsterdam Academy of Sciences*. The complete definite results, together with the isostatic reductions computed by the courtesy of the U.S. Coast and Geodetic Survey.

will be published by the Dutch Geodetic Committee in the course of 1928

Thanks to the skill of Dr. Vening Meinesz, the problem of the determination of gravity at sea is solved By his indefatigable effort and the splendid co-operation of the Royal Dutch Navy, the earth is now surrounded by a chain of gravity observations, which will procure the necessary data for a crucial test of the existing theories about the constitution of the earth's crust. Dr. Vening Meinesz has been appointed professor of geodesy at the University of Utrecht, and is now a member of the Dutch Geodetic Committee.

J. J. A. Muller.

## Forestry in Kenya Colony.

THE Forestry Department in Kenya has been in existence for more than a quarter of a century, the Forestry Ordinance dating from 1911. annual report for the year ended Dec. 31, 1926, it is claimed that the year then dealt with was "a notable one, and in many respects the most successful in the history of the Department " For the first time, it is said, the revenue was in excess of the expenditure. The revenue of £36,938 exceeded the expenditure by £7083 and was 45 per cent larger than that of any previous year. The Acting Conservator rightly remarks that a record exploitation of the forests would not necessarily imply a successful year. It might mean, he adds, as it has in many countries, record forest destruction and diminution of the capital forest wealth. Unfortunately, such destruction is still in force in different parts of the world. But it may be asked, is Kenya herself on sure ground in this respect? It is true the Acting Conservator points out that the record exploitation in Kenya in 1926 was accompanied by record progress in afforesta-tion and re-afforestation. "the area of 3047 acres planted during the year being more than sufficient to replace the forest cut during the year." It is not apparent, however, from the report, on what premises such a statement rests.

One of the most serious features of the present position of the Department and its forests is to be found in the fact that no trustworthy estimate of the quantities of timber in the forests exists; in other words, no enumeration of the growing stock as a whole in the forests under the Department has yet been made. This the report quite rightly states is "the most unsatisfactory aspect of the forestry position."

The exploitation work is carried out by sawmill companies, which are granted timber-felling licences. Twenty-three of these firms worked in the forest reserves during the year, the area subject to such exploitation being approximately 447,518 acres, though it is estimated that not more than 197,700 acres of this area carried marketable timber. "As the rate of cutting," says the report, "varies very greatly with the different licence-holders, the total area under licence is no guide to the rate of exploitation of the Colony's forests. The only sure criterion by which to judge the Colony's forest position is a comparison of the annual cut with a reliable estimate of the total stock of mature timber in the forests. There is at present no such estimate available, nor can one be obtained without a considerable increase of the present Staff of the Department."

The plain meaning of these statements is that the forests are being worked without an adequate knowledge of their contents or what is the annual possibility. It should not prove difficult to settle this important matter, if only roughly, in order to avoid the grave chance of overcutting. It is fairly common knowledge how Brandis, single-handed,

tackled a like proposition in Pegu in Burma in 1856. The Department in Kenya is obviously understaffed. But at least there is a trained officer in charge of each forest district. It can surely not be held that there is any work, however apparently important, not even planting work, which should take precedence over the carrying out of enumeration surveys, however rough, of the growing stock of the forests. For the exploitation work being conducted and the revenue accruing thereby is only justified, in economic forestry, when based on some adequate knowledge of the volume of growing stock per unit of area standing in the forests. Such knowledge, the Acting Conservator states, is non-existent. In its absence, fellings, according to modern forest practice and precept, should be made as sparingly as possible.

The other point in the report is the assertion that the planting work undertaken during the year, amounting to 3047 acres, is more than sufficient to replace the forest cut over during the same period. The volumes obtained from the latter were 1,316,566 cub. ft. of timber and 5,207,403 cub. ft of firewood. An analysis of the planting work shows that 1195 acres were planted as fuel plantations for the supply of firewood to the railway. This area has no reference, therefore, to future timber production. The planting work to replace the timber felling comprised 860 acres of pencil cedar, 276 acres of other indigenous timber species, and 274 exotic timber species, or an area of 1410 acres in all. The balance of 442 acres was mangroves Though admittedly a considerable portion of this planting work is still in the experimental stage, yet considerable success is being attained. Nevertheless, it appears somewhat optimistic, with the known history of the costly failures which have been experienced elsewhere in the past, to claim that this planting work will suffice to replace the forest areas cut during the year.

The report points to the necessity of undertaking research work in connexion with the forests and the need of special research officers. The beginnings of such research work have been initiated by the staff, and some very creditable work has already been achieved. Work of this nature, however, must be carried on with continuity, and the latter is not possible in the absence of the whole-time worker. But the mere enumeration of the growing stock of the Kenya Forests does not fall within the province of 'research.' It might be suggested that the best solution of this research question, as in the long run of the staff and its future prospects, would be the amalgamation of the gazetted forest staffs of the four colonies, Kenya, Uganda, Tanganyika, and Nyasaland, on to one list; following the precedent forced upon India some years after the Forest Service there was maugurated.

In conclusion, it should be said that this report is a most interesting document and beautifully got up by the Government Press, Nairobi. In this latter respect it forms a model which some other Colonial government presses might take as a guide.

# University and Educational Intelligence.

Cambridge.—Mi R. H. Fowler, Trinity College, has been elected Stokes lecturer in mathematics. Sir Michael Sadler has been appointed Rede Lecturer for 1928, and Prof G H Hardy has been appointed Rouse Ball lecturer in mathematics for 1928.

Girton College announces that a scientific research fellowship of the annual value of £300, tenable for three years, is offered for research in mathematical, physical, and natural sciences. Particulars are obtainable from the Secretary of the College. The latest date for the receipt of applications is Feb. 1.

London.—Applications are invited for the Keddey Fletcher-Warr studentships for post-graduate research The studentships are each of the annual value of not less than £200, are tenable normally for three years, and are open to men and women graduates of a British university, or who have passed an examination necessary to qualify for a degree, preference being given to a graduate of the University of London Applications should reach the Academic Registrar, South Kensington, S W 7, not later than Feb 20 next.

OXFORD.—The honorary degree of doctor of science has been conferred upon Mr. Edward Ball Knobel for his distinguished contributions both to astronomical science and to Persian scholarship. Dr Knobel has been president of the Royal Astronomical Society for two periods of office.

Among the financial decrees which have recently been brought before Congregation are those for the provision of senior studentships (£1000), for an assistant in the department of medicine (£150); for the botanical department (£450), and for providing and housing a destructor at the University Museum (£350).

A new botanical schedule for the Preliminary Examination has been published. It is to come into force on Oct. 1, 1929.

WITH the September issue of the Journal of the Imperial College of Tropical Agriculture, a 'Sugar Supplement, has been issued which describes briefly the system of training adopted at the Imperial College of Tropical Agriculture, Trinidad, for students in sugar technology, and also gives an idea of the courses of study available at that College for students in tropical agriculture. Before entering upon the special course of study in sugar technology, which occupies a year, the student must have gamed the diploma awarded by the College to those who qualify by examination after undergoing a three years' course of study; the qualification for entrance to the College being the matriculation certificate of any university within the British Empire or its recognised equivalent. The sugar technology course, which is fully described, includes instruction in genetic research on sugar-cane, sugar-cane breeding, agronomic research in the sugar industry, theoretical and practical instruction in the extraction of sugar from canes, by-products of the sugar industry, the components of sugar-cane juice, chemical research problems in sugar-cane production, organic manures from sugar-cane, insect pests of sugar-cane, mycological and bacteriological problems connected with sugar-cane, questions of hygiene connected with life in the tropics and work in factories, and costings and records connected with the management of sugar-cane estates and factories. In each case an outline is given of the course of instruction, whilst some thirteen illustrations depict various cultural operations and factory features.

### Calendar of Discovery and Invention.

December 18, 1879 —Huggins was a pioneer in the use of photography for the investigation of the physical condition of the stars. In 1864 he discovered that many of the nebulæ give spectra consisting of bright lines. In 1876 he obtained a photograph of the spectrum of Vega, and three years later, in a paper to the Royal Society, read on Dec. 18, 1879, he described the ultra-violet spectra of white stars.

December 19, 1844—Just after his return from England, Liebig, on Dec. 19, 1844, writing to Faraday, said. "What struck me most in England was the perception that only those works which have a practical tendency awake attention and command respect, while the purely scientific works, which possess far greater merit, are almost unknown . . . Here, in the eyes of scientific men, no value, or, at least, but a trifling one, is placed on the practical results. The enrichment of science is alone considered worthy of attention. I do not mean to say that this is better, for both nations the golden medium would certainly be a real good fortune."

December 19, 1898.—It was on this date that Prof. and Mme Curie communicated to the Paris Academy of Sciences a memoir, "Sur une nouvelle substance fortement radio-active contenue dans la pechblende," the substance being named by them 'radium.'

December 20, 1842.—Darwin made many experiments to study the action of earthworms. "One experiment lasted nearly thirty years, for a quantity of broken chalk and sifted coal cinders was spread on Dec. 20, 1842, over distinct parts of a field near Down House, which had existed as pasture for a very long time. At the end of November 1871 a trench was dug across this part of the field and the nodules of chalk were found buried seven inches. A similar change took place in a field covered with flints, where in thirty years the turf was compact without any stones."

December 21, 1736—The patent of Jonathan Hulls for a steamboat was granted on Dec 21, 1736. The following year he published a description of his new invention, but so far no evidence has been found showing that he ever put his ideas into practice.

December 22, 1666.—The Royal Academy of Sciences of Paris was founded by Colbert in 1666, and its installation took place by order of Louis XIV. on Dec. 22, 1666. At first there were only twentyone members, including three anatomists, two chemists, three physicists, three astronomers, and seven geometers. Huygens was included as a foreign associate.

December 22, 1896.—The Davy-Faraday Research Laboratory of the Royal Institution was founded and endowed by Ludwig Mond for furthering original investigations in chemical and physical science, and was opened by King Edward VII. on Dec 22, 1896, Lord Rayleigh and Sir James Dewar being appointed directors without remuneration.

December 24, 1801 — Trevithick was the first to run a locomotive on rails, but his earliest steam vehicle made its trial trip on the roads of Camborne on Christmas Eve, 1801. This vehicle was referred to ma Falmouth newspaper, which said · "A carriage has been constructed, containing a small steam engine, the force of which was found sufficient upon trial to mpel the carriage, containing several persons, against a hill of considerable steepness, at the rate of four miles an hour."

### Societies and Academies.

#### LONDON

Royal Society, Dec 8-R W. James and E M Firth · An X-ray study of the heat motions of the atoms in a rock-salt crystal The ratio of the intensity of reflection of X-rays by rock-salt at the temperature of liquid air, to that at room temperature, has been measured for a number of spectra The temperature factor is of an exponential form, the exponent being proportional to the square of the order of the spectrum. within the errors of experiment. The method of Fourier analysis has been used to calculate the distribution of electrons between the (111) planes of the crystal at different temperatures, and from the broadening of the peaks in the distribution curves the mean amplitudes of the atomic vibrations have been estimated.

I. Waller and R W James. On the temperature tactors of X-ray reflection for sodium and chlorine in the rock-salt crystal The factor for Na is greater than that for Cl, indicating that the Na atoms are the less firmly bound in the crystal lattice, and therefore have a greater mean amplitude of vibration than the From the values of the temperature factors the root-mean-square amplitudes of vibration of Na and Cl are found to be 0 242 A. and 0 217 A respec-tively at 290° abs Waller's theoretical formula for the temperature factor agrees with experiment from 86° abs to about 500° abs if allowance is made for

the difference in M tor the two atoms

N. K. Adam, W. A. Berry, and H. A. Turner The ructure of surface films (Part 10) Two series with structure of surface films (Part 10) liquid expanded films of area (at no compression) different from 48 sq. A have been found, the phenols of 39 sq A and the a-monoglycerides of 70 sq A. The hypothesis of coiled chains for the liquid expanded films cannot therefore be maintained. The evidence is inconclusive in favour of any specific form of a tilted molecule theory, although all forms appear possible. Since the heads appear to contribute to the cohesion in the expanded films, Langmuir's theory that the chains hold the films together against a disruptive force exerted by the heads appears incorrect. monoglycerides form condensed films with closepacked heads, not appreciably rearranged by compression, area 26.3 sq A at no compression. Muller's suggestion that the chains are tilted is not incompatible with the theory of close-packed heads. The condensed film of dodecyl phenol shows hysteresis on compression and decompression.

G. Nonhebel, J. Colvin, H. S. Patterson, and R. Whytlaw-Gray The coagulation of smokes and the theory of Smoluchowski A special cell has been designed for counting smoke particles The coagulation of clouds of ammonium chloride, antipyrin, and cadmium oxide obeys the same general law, which is probably valid for all smokes composed of non-volatile particles. The experimental data agree as closely as those obtained for sols with the theory of Smolu-

chowski

P I. Dee: The mobility of the actinium A recoil atom measured by the cloud method. The mobility of individual actinium A recoil atoms is measured at the instant of their reaching the ends of their recoil tracks. Photographs of four main types of grouped tracks were obtained, corresponding to the double disintegration: actinium emanation  $\stackrel{a}{\longrightarrow}$  actinium  $A\stackrel{a}{\longrightarrow}$ actinium B The relative positions of the origins of these tracks gave the mobility and, in some cases, the life of the A atom. Results obtained for actinium A agree with the usually accepted value for

the mobility, namely, 1.56 cm./sec/volt/cm. The method also gives direct evidence that some of the recoil atoms at the end of their recoil track are uncharged, and the percentage of such neutral recoil atoms agrees with Briggs's value, found by activity distribution methods

A. C. Menzies Shifts and reversals in fuse-spectra. A high-current arc is struck momentarily between The spectrum of copper so obtained has been compared with the low-current arc spectrum, and regularities have been sought on the bases of shifts and reversals. Five, and possibly six, new terms have been deduced, leading to the allocation of 32 new lines. Some of these are identified with terms missing from Sommer's scheme The lines which were reversed have final terms which belong to low levels; for copper they are  $1\,{}^2S_1$  or  ${}^2D_2$  or  ${}^2D_3$  terms. Lines have a tendency to shift as the current increases, for highlevel initial terms having structure (core +s), the lines shift to the red: for high-level initial terms having structure (core +d), the lines shift to the violet, for low-level initial terms, the lines shift in accordance with the Stark effect mainly

C G Darwin The electron as a vector wave spite of the great success of the spinning electron in the theory of spectra there are grave difficulties in its interpretation in terms of the wave theory. These are met by making the hypothesis that the wave of an electron, like a wave of light, has two components. The wave equations are worked out so as to fit the hydrogen spectrum, and this ensures that they will conform to all known conditions of quantum mech-They are found to be unsymmetrical, so that they take a different torm according to what direction of space is chosen as prime axis A general argument from analogy shows that they should therefore be interpreted in terms of a vector, in some degree arbitrary, so as to be invariant in form as well as fact A relativity transformation is applied, so as to identify the doublet effect 'with the Zeeman effect. This encounters the difficulty that it is not at present possible to see what form the Thomas correction should take in the wave theory, and so gives a value for the doublet separation twice as great as it should be.

W. Sucksmith, H. H. Potter, and L. Broadway. The magnetic properties of single crystals of nickel magnetic properties of single crystals of nickel have been examined in the principal crystal planes component of magnetisation parallel to the field was measured by the induction method, whilst the component perpendicular to the field was measured by a torsion method. The existence of directional properties in the crystal invalidates the torsion method for the measurement of the parallel component. The magnetisation and field coincide along the directions of the symmetry axes, the direction of easiest mag-

netisation being along the trigonal axis.

L. N G. Filon: On the second approximation to the "Oseen" solution for the motion of a viscous fluid. We start from the "Oseen" solution as the ' first order' and substitute this first order solution into the terms previously neglected in the exact equations of motion (restricted, however, to steady motion). We then obtain integrals of the modified equations. The new solution contains a certain term in which  $\log r$  appears as a factor, r being the distance from the obstacle. This term, when the torque on the cylinder is calculated, leads to a result logarithmically infinite The force resultants remain finite and the expressions obtained for them from the "Oseen" solution remain unmodified.

C. V. Raman and K. S. Krishnan: A theory of the optical and electrical properties of liquids. The theory is based on the idea that the molecules of the fluid are optically and electrically amstropic, and that, in addition, the polarisation field acting on a molecule in a dense field varies with its orientation relatively to the external field. It offers an immediate explanation why in general an increased density causes a diminished molecular refractivity as calculated from the Lorentz formula. These changes in refractivity and dielectric constant are closely related to a change in the effective optical or electrical anisotropy of the molecules produced by the influence of its immediate neighbours. Similar ideas have been adopted in theories of electric birefringence and of light-scattering in liquids developed by the authors, which have found strong experimental support.

strong experimental support E W R. Steacie and F N C Johnson The solubility of hydrogen in silver The solubility of hydrogen in silver has been investigated from 200° to 900° C, at pressures of 5-80 cm. The solubility first becomes appreciable at 400° C The solubility increases exponentially with increasing temperature. It is proportional to the square root of the pressure. The diffusion of hydrogen through quartz has also been measured from 200° to 900° C. The diffusion of hydrogen through quartz appears to be of a mechanical

nature.

R L. Smith-Rose and R H. Barfield Further measurements on wireless waves received from the upper atmosphere. The results previously published were confined to measurements on waves received from the Bournemouth transmitting station. The investigation has been extended to transmissions from Birmingham, London, and Newcastle Measurements have been made of the mean angle of incidence of the downcoming waves, and from these the effective height of the upper ionised layer has been calculated. By making use of a knowledge of the attenuation of the surface wave over land, it has been possible to arrive at values for the coefficient of reflection of the ionised layer for the various cases dealt with.

(To be continued)

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#### DUBLIN

Royal Irish Academy, Nov. 30.—P. J. Nolan and Chlan O'Brolchain Observations on atmospheric electrical conductivity in connexion with the solar eclipse of June 29, 1927. Observations made at Llysfaen, Colwyn Bay, showed no variation in conductivity which could be attributed to the eclipse. The relation between the conductivity and the concentration of condensation nuclei was, however, anomalous. An explanation of the anomaly is put forward. Records of ionisation, conductivity, and nucleation under normal conditions are examined, and values for the rate of production of ions in the free atmosphere at different places are computed.

#### Paris.

Academy of Sciences, Nov. 14.-H. Deslandres: Observations on the transit of Mercury across the solar disc, Nov. 10, 1927, made at the observatories of Paris and Meudon All possible instruments at both observatories were utilised, but the atmospheric A general account conditions were not favourable of the work done is given: details of the measurements will be given in a later communication.— G. Bigourdan · The transit of Mercury across the sun observed at the Paris Observatory on Nov. 10, 1927. There was no sign of the ring round the planet noticed in some earlier observations - Maurice Hamy: Observation of the transit of Mercury across the sun on Nov. 10, 1927. On account of the unfavourable atmospheric conditions, only the second interior contact could be observed .- Maurice Hamy: An eyepiece permitting the images to be rotated.—Pierre

Some results of the Congress of the Carpathian Association held at Bucharest in September the crystallino-mesozoic zone provisional sketch on the whole of the structure of the Carpathians - P A Dangeard Researches on the natural contamination of the soil in cultures of Phascolus rulgaris The Rhizobium of the bean does not exist in a soil which has remained uncultivated for several Contamination of the soil by the Rhizobium is most easily accomplished by adding soil containing the germs of the organism, or more simply by watering with water with which such soil has been in contact .-Georges Claude. The utilisation of the thermal energy of the sea. A detailed reply to criticisms of the scheme proposed by Paul Boucherot and the author on the utilisation of the sea's thermal energy.—(1. Charpy A method for the superness satel. The process suggested by the author, and the steel from comentation, named carbunsation as distinct from cementation, consists in heating the steel to a temperature between 600° C. and 650° C m an atmosphere of carbon monoxide, cyanogen, or hydrocarbons Gonnessiat Observation of the transit of Mercury at the Observatory of Algiers Twenty negatives were taken under fairly good atmospheric conditions · a full discussion of these will be given later -- A Recoura · The sulphates of acetylated sesquioxides -Ed Imbeaux. The subterranean waters, the principal cause of the inclination of the leaning tower of Pisa. How can its stability be assured? Means are suggested for stopping the flow of the underground water at the base of the tower, afterwards consolidating the foundations with cement.-E Bataillon . The destiny of the male nuclei in the crossed impregnation of immature eggs of the Triton.—Albert Calmette was elected a member of the Section of Rural Economy in succession to the late G André.—Eugène Cahen The ensemble of all integral algebraical numbers G Nicoladzě The generalisation of a theorem of Bertini. -Miloch Radoitchitch The approximation of multiform analytical functions by algebraical functions. - Y Rainich: The indices in a field of tensors. The generalisation of integral curvature.—Kolossoff The centre of nonparallel forces - E Carafoli. The acrodynamic profiles of general form —E. Huguenard, A. Magnan, and A. Planiol. A new principle permitting the realisation of apparatus measuring the aerodynamical conditions of the flight of aeroplanes.--Schaumasse · Observation of the transit of Mercury across the sun's disc made at the Observatory of Nice - Times of the last internal and external contacts are given—(† Van Biesbroeck: The rediscovery of the Schaumasse comet and the photographic method for observing comets. This comet was found on Oct. 4, almost exactly in the position predicted by G. Merton It appeared as a faint nebulosity of the 12th magnitude. It was afterwards observed on Oct. 8, 19, 21, 25, and 26. The advantages of the photographic method are pointed out.—J. Nageotte The microscopic and molecular structure of myelinic formations. Dubar. A verification of the theory of detectors and contact rectifiers. Description of experiments with a detector formed of blocks of graphite and silicon, separated by a very thm film of silica —G. W. Ritchey The comparison in the laboratory of the images and the fields furnished by a Newtonian telescope and a Ritchey-Chrétien telescope.—Y. Rocard The rôle of the vibrations of the atoms in the molecules in the phenomenon of the diffusion of light.—G. Labussière. The production of light by the friction of the diamond on glass.—Pierre Bricout: The absolute measurement of the luminous energy emitted by a gas submitted to electron bombardment. From the results of the measurements recorded, the conclusion is drawn that there is a high probability that for each collision of

an electron and an atom one quantum is emitted Hence all the shocks are efficacious for the production of the radiation.—L Mallet and R Cliquet A photoelectric cell for the measurement of mean ultra-violet The best metal for the cell proved to be an alloy of silver and cadmium, the emission from which commences for a limiting wave-length of about 2900 A. The cell is free from mertia and photoelectric fatigue and is unaffected by ordinary daylight or by any sources of light surrounded by a glass covering —R Moens and J E Verschaffelt Optical phenomena presented by quartz put in piezo-electric vibration—René Dubrissay and Mile Florence Desbrousses The action of phosphonic acid on lime-stone in the presence of clay and of powdered substances The presence of absorbent materials. especially kaolin, interferes with the fixation of phosphoric acid by chalk. This action is notable even when the proportion of chalk is such that there should be sufficient to transform the whole of the acid into insoluble phosphate—René Wurmser. The apparent potential of solutions of glucose—Jean Cournot. The treatment of terrous alloys in solutions of complex phosphates, with the view of their protection against corrosion. The method of treatment is to dip the iron, cast iron, or steel into boiling acid baths containing from 3 per cent to 4 per cent of phosphates of iron and manganese prepared with orthophosphoric acid. The treated metals are especially resistant to atmospheric coirosion; corrosion tests in various liquids are described. showing comparative results obtained by specimens protected by various processes —Travers · Analytical consequences of the domain of stability of cryolite The questions of the separation of silica and fluoride in the presence of aluminium, and the estimation of fluorine and silica are considered in the light of the results given in an earlier communication. - B. Bogitch · A method of removing iron from an alloy — V. Hasenfratz and R. Sutra . The chemical properties of benzylidene-harmine This substance, although containing a double bond, forms no addition product with bromine. Only one of the two nitrogen atoms which it contains can be methylated .- R Barré · The action of organo-magnesium derivatives on tetraethyloxamide.—Frèrejacque Oxyquinine and per-oxyquinine.—Maurice Fontaine The causes of a variation of the salinity observed in the ocean at the promontory of Croisic. The reduced amount of salt is shown to be due to the Loire—Ph Hagene Colonies of species attacking chalk in a limestone region.—Raoul Combes and Robert Echevin: The velocity of the autumnal migration of the nitrogenous substances of leaves towards the stems in ligneous plants — René Souèges The embryogeny of the Leguminoseæ. The first stages of the development of the embryo in Medicago Lupulina — Lucien Daniel The heredity of wormwood (Artemisia) grafted on Chrysanthemum frutescens - Jacques Pellegrin. The presence of the green trog in the Hoggar (Central Sahara)—Mine L Random and R. Lecoq. The influence of the nature of the alimentary glucides on the production of acute polyneuritic states, relapsing or chronic, obtained in spite of the presence of yeasts or extracts of yeast -Mlle. M L. Verrier: The static refraction of the eye in fishes.-Marcel Brandza · The fusion or separation of the plasmodia, taken as criteria m the definition of the species m the Myxomycetes.— Edouard Chatton and André Lwoff: The metamorphoses in the Foettingeridæ (ciliated) and the transformations of their culature in the course of their evolutive cycle.—K Toumanoff Attempts at the mmunisation of bees. Bees possess a great natural immunity with regard to various organisms. It was

proved that immunity against B alree could be conterred on bees—S Schmidt—Contribution to the study of the process of neutralisation between toxins and antitoxins (diphtheria and tetanus). These experiments show that the complex formed by the toxin and the antitoxin in excess react with a new quantity of the toxin differently from free antitoxin—E. Wollman and Achille Urbain. Antigen autonomy of the saicoma of Roux.

#### CAPE TOWN.

Royal Society of South Africa, Sept 28.-P R. v d R Copeman Studies in the growth of grapes (Pt 5). The relationship between the sugar and soluble solids in the juice of the grape is a linear function The slope of the line is closely related to the growth yields of these two factors during the period of ripening. The variations of the constants for different varieties lie within narrow limits and it is possible to obtain a general expression for the sugar in terms of the soluble solids, which is practically independent of changes in locality and season.—M. R. Drennan The dentition of a Bushman tribe The collection comprises the remains of 53 individuals reputed to be Bushmen. Comparative data from the dentition of the Kaffir and a few gorillas and baboons are discussed—D Slome The osteology of a Bushman tribe Skeletons of a tribe of aborigines exhumed at Colesberg by the South African Museum, Cape Town, were examined. The larger group examined is composed of relatively pure Bushmen, more typically Bushman, especially as regards the smallness of their bones, than many other groups which have been described as Bushmen Nevertheless, there appears to be a strain of what might be termed Hottentot blood in them, as evidenced by the narrowing of the skull, and the apparent subnasal prognathism —James Colour and chemical constitution (Pt. 23) The pigments of flowers The gap between the anthocyanidines and their parent, flavylium chloride, has been filled by synthetic derivatives. All the anthocyanidines, except the simplest, possess from three to five different shades, each according to the reaction of the solution.-Lancelot Hogben and Louis Mirvish . Some observations on the production of excitement pallor in reptiles Excitement pallor in chameleons is shown by spinal transection to be determined by a segmental mechanism. The possibility of evoking pallor by stimulation of the cord in isolated segments after the circulation has been cut off indicates that the pigmentary effector organs are under direct nervous pigmentary effector organs are under direct hervous control. It is unlikely that adrenal secretion plays any significant part.—E. L. Gill. Note on a rorqual burned on the Cape Flats. A skeleton of a rorqual (Balænoptera sp.) has been found in surface deposits on the Cape Flats, near Maitland. The circumstances furnish evidence of a comparatively recent rise of level of the Flats in relation to the sea.—Vincent A. Wager. The structure and life history of the South African Lagarosiphons.

SYDNEY.

Linnean Society of New South Wales, Sept. 28.—P. Brough: Studies in the Goodeniaceæ (Pt. 1). The life history of Dampiera stricta R Br. A detailed account is given of the chief phases in the life history of Dampiera stricta R Br.—a representative of the family Goodeniaceæ. Therein are presented organogeny, microsporogenesis, megasporogenesis, female gametophyte, male gametophyte, pollination mechanism, tertilisation, endosperm formation, embryogeny, and conclusions arrived at, as a result of the facts brought out by this investigation.—J. R. Malloch. Notes on Australian diptera (No. 13). This paper deals with the families Sapromyzidæ, Agromyzidæ,

Chloropidæ and Astendæ Numerous keys to both Sixty-four new species genera and species are given are described, distributed as follows .- Sapromyzidæ 34, Agromyzıdæ 6, Chloropidæ 23, Astendæ 1—A. H. S Lucas. Notes on Australian marine algæ The Australian species of the genus Spongo-(Pt. 4). The critical distinction between Spongoclonium clonium and Lasiothalia seems to be that the former is monosiphonius, articulated, without any true cortex, and thus nearer to Callithamnion, while the latter possesses a true cortex and is nearer Crouania object of the present paper is to illustrate so far as material will permit the Australian and Tasmanian species included by De Toni in the genus Spongoclonium. Eight species of Spongoclonium and two species of Callithamnion, which had been included in Spongoclonium by De Toni, are figured

#### Official Publications Received.

Official Publications Received.

British

Proceedings of the Royal Society of Edinburgh, Session 1920-1927

Vol 47, Part 2, No 21 Submergence and Postural Approx in the Swan By D Norl Paton Pp 2852-293+1 plate 18 vol Vol 17, Part 3, No 22 Researches into the Characteristic Numbers of the Mathieu Equation (Third Paper) By Dr E I Ince Pp 294-301 vol (Edinburgh Robert Grant and Son., London Williams and Norgate, Ltd)

Bittish Cast Iron Research Association Sixth Annual Report for the Year ending June 30th, 1927 Pp 22. (Birmingham)

Livingstone College Annual Report and Statement of Accounts for the Year ending June 30th, 1927 Pp 22. (Birmingham)

Livingstone College Annual Report and Statement of Accounts for the Year 1926-27 Pp 24. (London Leyton, E 10)

Royal Geographical Society Inst of Honorary Members and Corresponding Members and Fellows. Corrected to 30 September 1927 Pp 136. (London) To be obtained by Fellows only

Journal of the Indian Institute of Science Vol 10A, Part 5 isocience Aced By Tahiham Jethanand Mirchandam and John Lionel Smionsen Pp 57-63. Samas Vol 10A, Part 6 Note on the Sorting, Classification and Briquetting of Chrome and Manganese Ores By K Rishnaswami Pp 55-69 Samas Vol 10B, Part 1 Tests on Suspension Insulators after The Years' Service By A S Venkateswama and U. Ganguly Pp 19 1 rupee Vol. 10B, Part 2 The Measurement of Voltage Gradient on a String of Suspension Insulators By G Yoganaddam and R K Sen Pp 21-33 1 rupee (Bangalore)

Sanatoria List of Sanatoria and other Residential Institutions approved by the Minister of Health for the treatment of persons suffering from Tuberculosis and resident in England and Wales, with the names of the Administrative Counties and Country Broughs in which the Institutions are straate. (List 10(c)) Pp. 24 (London) H M Stationery Office) 2d. net

Umon of South Africa Department of Mines and Industries Geological Survey The Geology of the Country around Vredefort an Explanation of the Geological Map B Louis T Net Pp 134+15 plates (Pretoria Government Prin

and Jackson )

International Federation of University Women. Bulletin No 9
Report of the Council Meeting, Vienna, July 1927. Pp 72 (London Crosby Hall)

The Manchester Museum. Museum Publication 94 New Carboniferous Lamellibranchs and Notes on other Forms. (Notes from the Manchester Museum, No. 31.) By J Willind Jackson Pp. 93-122-43 plates. 38 Museum Publication 95 Report of the Museum Committee for the Year 1926-27. Pp 23 3d (Manchester University Press; London Longmans, Green and Co., Ltd.)

#### FOREIGN.

Foreign.

Scientific Papers of the Institute of Physical and Chemical Research.

No. 105 The Synthesis of \$\tilde{L}\$-\text{Acid} (2\text{-eDioxy}\text{quinoline-4} Carbonic Acid) obtained from "Rob-Oryzann" by Hydrolysis By Yoshikazu Sahashi. Pp 21\tilde{2}5 of sen. No 106. Resonance Radiation in the Excited Neon By Yoshio Fujoka. Pp 27\tilde{3}4\tilde{p} plates 1-4. 25 sen. Nos. 107\tilde{1}08 The Effect of Alkah on the Oxidation of Ferrous Hydroxide with Air, by Susumu Miyamoto, The Effect of Alkah on the Oxidation of Sodium Sulphite with Air by Susumu Miyamoto. Pp. 35\tilde{4}5. 25 sen. Nos. 109\tilde{1}10\tilde{0}0 on the Pehydration of Borneol, by Tetsusaku Ikeda; On the Formation of Campaiene from Pimene Hydrochlonde, by Tetsusaku Ikeda Pp. 47\tilde{7}3 35 sen. Nos. 112\tilde{1}14\tilde{1}4, A new Material for the Study of Photo-Elasticity, by Ziro Tua; Photo-Elastic Study of Stress on a Specimen of Three Dimensional Form, by Ziro Tua; Phylo-Elastic Study of Stress in Heat-ticated Column, by Ziro Tua; Phylo-Elastic Study of Stress in Heat-ticated Column, by Ziro Tua; Phylo-Elastic Study of Stress in Heat-ticated Column, by Ziro Tua; Phylo-Elastic Study of Stress in Heat-ticated Column, by Ziro Tua; Phylo-Selastic Study of Stress in Heat-ticated Column, by Ziro Tua; Phylo-Selastic Study of Stress in Heat-ticated Column, by Ziro Tua; Phylo-Selastic Study of Stress in Heat-ticated Column, by Ziro Tua; Phylo-Selastic Study of Stress in Heat-ticated Column, by Ziro Tua; Phylo-Selastic Study of Stress in Heat-ticated Column, by Ziro Tua; Phylo-Selastic Study of Stress on a Specimen of the Hydrogenatu on of "Biosterin" By Ziro Nakaniya and Kozo Kawa-kam. Pp. 12\tilde{1}-142 30 sen. Table No. 2 Tables to Facilitating the Calculation of Self-Inductance of Circular Coll and of Muthal Inductance of Conval Circular Currents. By Hantaro Nagaoka and Sadazo Sakurni Pp. 6\tilde{1}-150 3 sen. (Tokyo Iwanami Shoten)

The University of Chicago Publications of the Yerkes Observatory Vol. 4, Part 6 Zone +45° of Kapteyn's Selected Areas, Photographic Photometry for 1500 Stars By John Adelbert Parkhuust. The preparation for Publication was completed after the Author's death by Albert Hall Farnsworth Pp. vn+62 150 dollars. Vol. 5, Part 1 Measurements of Double Stars. By George Van Biesbroeck. Pp. v+265 3 dollars. (Chicago University Of Chicago Press, London Cambridge University Press.)

dollars (Chicago University of Chicago Press, London Cambridge University Press)

Memoires de la Societe de Physique et d'Histoire naturelle de Geneve vol 10, Fascicule 3 Rapport du President de la Societe de Physique et d'Histoire naturelle de Genève pour l'annee 1925, par Émule Chaix, Les mollusques post glaciaires étactuels du bassin de Genève, par Jules Favre Pp. 10c443++planches 14-27 (Genève Georg et Che) 20 francs

Proceedings of the United States National Museum Vol 72, Art. 2 Undescribed Grane Flies from the Holarctic Region in the United States National Museum By Chailes P Alexander (No 2098) Pp 17+1 plate Vol 72, Art. 8 New Parasitic Hymenoptera of the Subfamily Anteoninae from the Americas By F A Fenton (No 2098) Pp 18+2 plates (Washington, D C Government Printing Office)

The Government of the Philippine Islands Department of Agricultura and Natural Resources Bureau of Science The Mineral Resources of the Philippine Islands for the Years 1924 and 1925 Issued by the Division of Geology and Mines, Bureau of Science Pp 148+5 plates (Manila Bureau of Printing)

Ministry of Public Works, Egypt Physical Department The Lake Plateau Basin of the Nile Second Part By Dr 11 E Huist (Physical Department Paper No 23) Pp vii+66+28 plates (Cairo Government Publications Office) 10 PT

Ministry of Agriculture, Egypt Technical and Scientific Service

Department Paper No 23 ) Pp vii+66+28 plates (Cano Government Publications Office) 10 P T
Ministry of Agriculture, Egypt Technical and Scientific Service (Plant Protection Section Entomological Research Division), Bulletin No 76 Key to Identification of Egyptian Scorpions By Dr. L. H. Gough With Notes and Additions by Stanley Hirst. Pp 11+7+5 plates (Cano Government Publications Office) 5 P T
New York Academy of Sciences Scientific Survey of Porto Rico and the Virgin Islands. Vol. 9, Part 3. The Birds of Porto Rico and the Virgin Islands. Colymbitorines to Columbitorines, By Alexander Wetmore Pp 245-400+plates 55-61 (New York City)
Department of Commerce U.S. Coast and Geodetic Survey. Special Publication No 135. Tidal Datum Planes By H.A. Mainer Pp vi+12 (Washington, D.C. Government Printing Office). 30 cents.
Department of the Interior Bureau of Education. Builletin, 1927, No. 23 Pension Schemes for Public School Teachers. By Nida Pearl Palmer. Pp vi+84. 15 cents. Builletin, 1927, No. 20 Industrial Education in 1921-1926. By Mais M. Profitt. Pp. 29. 5 cents (Washington, D.C. Government Printing Office).
Cornell University Agricultural Experiment Station. Memon 106 Catalase in relation to Growth and to other Changes in Plant Tissue By J. E. Knott. Pp. 64 (Ithaca, N.Y.)
Proceedings of the California Academy of Sciences. Fourth Series Vol. 16, No. 20. Notes on New or Rate Fishes from Hawan. By David Stail Joidan, Batton Warren Evenmann and Shigeho Tanaka. Pp. 649-680+plates 22-24 (San Francisco, Cal.)
Conseil Permanent International pour Texploitation de la Mei Rapports et Ploces-verbaux des Reumons. Vol. 45, Proces-verbaux (Mai 1927). Pp. 153. (Copenhague Andi Fred Host et ills.)

#### Diary of Societies.

#### SATURDAY, DICLMBER 17

NORTH OF ENGLAND INSTITUTE OF MINING AND MICHANICAL ENGINEERS (Newcastle upon-Tyne), at 2:30 — W C Carr Impressions of the Canadian Empire Mining Congress.—Dr W Hopkins Further Modifications of the Correlation of the Coal seams of the Northumber land and Durham Coalheld—Paper open for further discussion—Notes on an Intush of Witer it the Montagu Colhery, Scotswood, Northumberland, on March 30th, 10:25, by H T Foster

ROYAL INSTITUTION OF GREAT BEITAIN, at 3—F J M. Stratton Recent Developments in Astrophysics (II)

#### MONDAY, DECLMIER 19

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 -D1 R Miller, in conjunction with J E Franck Some Medical Aspects of Damp in Dwellings

EVELLING
ROYAL GEOGRAPHICAL SOCIETY (at LEDIAN Hall), at 830—Capt S W Kirby, Jahore in 1926
BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Medical Society of London, 11 Chandos Street, W), at 830—19; J A Hadheld The Rehability of Infantile Memories CHEMICAL INDUSTRY CLUB

# TUESDAY, DICIMBER 20

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5 15 -L R Connor. Certain Aspects of the Distribution of Income in the United Kingdom in the Yeals 1913 and 1924
ROYAL SOCIETY OF MEDICINE, at 5 30 -General Meeting

ROYAL PHOTOGRAPH: SOCIETY OF GRAIT BRIAIN, at 7—Demonstra-tions of New Apparatus
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30—Dr A H Mumford
Body Measurements, Respiratory Tests and School Progress.

ROYAL METEOROIOGICAL SOCIETY, at 5.
INSTITUTION OF CIVIL ENGINEERS (Manchester and District Association) (at 36 George Street, Manchester), at 0.45 — W. H. G. Mercer. Notes on Sewage Works Design (Activated Studge Process)
NORTH EAST COAST. INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middle-brough Branch—Graduate Section) (at Middle-brough), at 7.30 — R. F. Battey. The Progress in Diesel Design Institute of Chemistry (London Section).



# SATURDAY, DECEMBER 24, 1927.

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# Needs of Empire.

THE many recommendations submitted to and passed by the delegates of the recent Imperial Agricultural Research Conference have a familiar In substance they are almost identical with those endorsed by the delegates to the Colonial Office Conference held earlier in the year, and in principle they do not differ from those which were submitted to the Imperial Conference of 1926 by the Research Sub-Committee over which Lord Balfour presided, or those contained in the Report of the Imperial Agricultural Research Committee which was published this year Unfortunately, this Conference, like those which preceded it, has not been able to base its recommendations upon an assured income guaranteed by the Imperial Parliament or the beneficiary governments of the It has not even been definitely promised that necessary financial provision will be made for any part of the programme of activities outlined in the recommendations The Conference had to be content with vague hints that support for various schemes of scientific research and technical development would be forthcoming from the Empire Marketing Board, the Department of Scientific and Industrial Research, and other bodies with public funds at their disposal, and the expressed hope that Dominions and other overseas governments might be found willing to contribute to a central fund

The sub-committee of the Conference which dealt with 'Recruitment and Training' emphasised the need for the "immediate reinforcement of activity" to attract candidates of the highest class for the colonial agricultural service and to equip them with They are to be attracted the best possible training by the 'immediate betterment of emoluments, facilities for work, and superannuation arrange-"The inducement in the form of ments." scholarships of any kind" must be considered "wise and fair only if the service be made to provide really good careers." This sub-committee realised that persons with a distinct flair for research must be offered special inducements to take up duties in comparative isolation in any of the existing or proposed links in the chain of the overseas research stations Yet in introducing the Research Stations' Major Walter Elliot suggested that £20,000 per annum was " the sort of figure which one could have in mind in considering the setting up of a station" for the running of which "something like 10 highly qualified men will be necessary as the superior staff."

It is difficult to see how really good careers are to be provided out of this estimated annual cost of running a research station, which is to include the salaries of the staff (superior and minor), equipment and materials, and presumably, travelling expenses—a considerable item. It is not without significance that this estimate passed unchallenged by any member of the Conference Of even greater significance, perhaps, is the fact that throughout the Conference no authoritative and definite statement was made as to what scale of salary was regarded as synonymous with a Undoubtedly there are really attractive career other important considerations to be taken into The intrinsic interest of the work, the facilities offered for and the degree of freedom in research, the scope given for trying-out large scale experiments, will directly influence the choice of a research worker for a particular institution these are the considerations which weigh with those who have already specialised in a particular Those which usually carry branch of science most weight with headmasters who are advising boys on their choice of subjects at the universities are the material rewards offered by the careers associated with their university studies deplorable it may be that very few facilities exist in our boys' schools for biological training, the fact has to be faced that there is little demand from parents for such facilities, the absence of the demand being determined by the present comparative material unattractiveness of biology as a career. Once it is realised by parents and headmasters that not only are trained biologists essential for the development of certain branches of industry, but also that governments and leaders of industry are sufficiently appreciative of the need for such services to offer substantial inducements to those who can provide them, some training in biology will be provided in the schools.

This Conference was given every facility for putting the claims of scientific research before the Empire. Those responsible for the press arrangements did their work most efficiently; it is the members of the Conference who are to blame for not making better use of their opportunities for publicity, the quickest and surest way of stirring the imagination of the public. From beginning to end of the Conference no speech was delivered which dealt arrestingly with the problem of agricultural research as a whole, which attempted to place before the public even a rough estimate of the annual cost to the Empire of the neglect of research, or of the annual yields to the Empire of certain

specific results obtained in agriculture through the application of research

For example, no reference was made to the triumphs of Clouston and Howard in India in connexion with crop production, the amazing rapidity with which application followed research: no estimate was given of the value of the work of Theiler in stamping out the rinderpest in South Africa · the public was provided with no accurate information regarding the additional area placed under cultivation in the Empire as the direct results of experiments in plant acclimatisation and adaptation to soil conditions Similarly, none of the arresting and illuminating statistics were given of the losses sustained by agriculturists through the ravages of insect pests, fungi, unsound irrigation and faulty dramage, or those due to unscientific storage, packing, and transport. Diseases afflicting domestic stock in various parts of the Empire were mentioned, but no emphasis was laid upon the financial aspects of animal disease, or the disastrous effects of cattle epidemics on the social life of the primitive peoples for whose welfare we have assumed responsibility. Again, no clear picture was drawn of the fallow but potentially crop-producing area in the Empire, the possibilities of British tropical and sub-tropical Africa as the greatest cotton-producing area in the world, of the future capacity of Canada and Australia for wheat cultivation, or of New Zealand's exceptional advantages for cattle-raising.

More serious still was the omission of detailed statistics regarding the cost to the various governments represented at the Conference of those departments dealing with the inspection and cure of aling plants and animals. This cost was not compared with the sums made available for applied research, although it appeared to be realised that the results likely to accrue from research are incalculably greater than those from the application of empirical specifics. None of the parliamentarians present took the opportunity of bringing to the notice of the delegates or the country the sums allocated to agricultural research by the United States or by Holland.

It may be urged that information on these several points was already in possession of the delegates. Even if this were true—and it certainly is not—advantage should have been taken of a favourable occasion to place such information before that larger public which is still indifferent through ignorance to the claims of scientific research for more generous treatment. Since it was not, we can only commend to the attention of the Empire Marketing Board the possibility of

bringing some at least of this information before the public through the medium of posters. The work of Lawes and Gilbert, although the beneficence of its scope is not confined to the British Empire, places them on at least an equal footing as Empire builders with the statesmen, soldiers, and sailors whose portraits adorn our hoardings. It may be a vain assumption, but we incline to the opinion that were the facts regarding the beneficial effects of research on agriculture and industry in general better known, the public would not merely acquiesce but demand greater provision for expenditure under this head

From many points of view, however, this Conference was a success It brought together experts and those responsible for the administration of the agricultural services from the overseas parts of the Empire to co-operate with those who bear like responsibilities at home Not only the overseas delegates, but also many of the home delegates, were granted exceptional facilities for making themselves acquainted at first hand with the work of the staffs at most of the important research institutions bearing on agriculture in Britain The series of reports resulting from their joint labours are invaluable contributions to the cause of agricultural research The principles enunciated in the report on "Recruitment and Training" are un-The only pity is that no challengeably sound appendix was attached with information regarding existing methods of appointment and conditions of service in the various home and overseas departments of agriculture and research institutions, together with an estimate of the number of vacancies likely to occur within say the next five years.

In the report on "Tropical and Sub-Tropical Research Stations," the opinion is expressed that "the control of a station should be so vested as to ensure that the work of the institution should not be diverted from a programme of free research" and that such research should be of "long range" and "wide range" character, serving the needs of several territories, reinforcing but neither impairing nor replacing the scientific work properly undertaken by the agricultural department of any government in its vicinity. In addition to the existing stations, namely, the Imperial College of Tropical Agriculture, Trinidad, and the Amani Institute, Tanganyika—lately resuscitated—the provision of five new research stations is indicated. The Australian Commonwealth Government already has a definite plan for the establishment of a station to deal chiefly with animal husbandry, nutrition and pathology, and other stations are contemplated in Ceylon, the Federated Malay States, and an additional centre in East Africa for animal diseases research, although the report indicates that the South African Animal Research Station at Oudersteport must have first consideration as the primary centre for such work. This particular report concludes with a recommendation for the establishment of a central research station to investigate the subject of irrigation, including its engineering, agricultural, chemical, and physical aspects

The third report on administrative matters deals with the establishment and development of effective clearing-houses for the interchange of information of value to research workers in agricultural science throughout the Empire The committee recommended and the Conference agreed to the establishment of three bureaux, a Bureau of Soil Science attached to the Rothamsted Experimental Station, a Bureau of Animal Nutrition attached to the Rowett Institute, and a Bureau of Animal Pathology in London. In addition, it is proposed to set up correspondence stations, for animal genetics at Edinburgh, for agricultural parasitology at the London School of Hygiene and Tropical Medicine, for plant genetics at Cambridge and Aberystwyth, and for fruit production at the East Malling Research Station. It is estimated that the three bureaux will cost £13,000 per annum, and the four correspondence centres £7000 per annum

These last recommendations stirred Sir Damel Hall to the observation, "I grudge every penny of research money which is diverted to the administrator, to the editor, to the indexer, and people of that type. . £20,000 a year represents an estimated cost on an Empire Research Station of the first order" His objection was overruled, both by administrators and research workers. But the principle underlying his objection is sound It is not more administrators of research that are wanted, but more research workers, and although the sum of money involved may seem an insignificant item of expenditure spread over the budgets of the Empire governments, it assumes significant proportions in relation to the expenditure of these governments on true agricultural research can only suggest that the research workers themselves give their serious attention to the diversion of their energies on matters of administrative routine having little bearing on high policy, and be ready to present a working plan of their own for the interrelation of their activities to the next Conference, which is to assemble in Australia in five years'

# Teaching and Research in Organic Chemistry.

Recent Advances in Organic Chemistry. By Prof Alfred W. Stewart Fifth edition Vol. 1 Pp xiv +387. 21s. net. Vol. 2 Pp xiv +382. 21s net. (London. Longmans, Green and Co, Ltd., 1927.)

THE new edition of Prof Stewart's account of recent advances in organic chemistry conveys an immediate impression of the immense current activity in this field, since the author has now found it necessary to expand the work from one volume to two. The rising tide of research papers in chemistry, and particularly in organic chemistry, has, indeed, become something of an embarrassment during the last few years. Despite the introduction of a rigorous scrutiny of contributions, the publication committees of chemical periodicals find difficulty in compressing the material submitted within reasonable limits; librarians are becoming concerned at the increasing demands which are being made upon their housing accommodation; and last, but not least, individual members of chemical societies view with pardonable disquietude their unenviable duty of making pecuniary provision for the printing of a vast output of literature, which for the most part is so highly specialised as to carry little general appeal

Notwithstanding this state of affairs, few chemists will welcome the recent suggestion to observe a ten years' armistice in research. Moreover, although many may be able to accept in its literal sense Prof. Stewart's opinion that if seventy per cent. of the known organic compounds had never been synthesised, we should not miss them, few will regard the task of preparing them as a work of supererogation. Cannot that somewhat pathetic array of 'still-born organic compounds'—the epitaphs of which, according to our author, are inscribed in Beilstein's truly monumental "Handbuch"—be regarded more hopefully as byproducts in the acquirement of experience in research?

Formerly, it was lamented that so little chemical research was being conducted in Great Britain. During the last few years, however, there has been a growing demand in the British chemical industry for chemists with a postgraduate experience of research; and this demand is being fulfilled. Whether suitable candidates for such appointments have gained the Ph D. degree or not, it may be admitted that each one of them in a sense "represents so many new compounds," and thus contri-

butes to the "enormous flood of synthetic material" for which Prof Stewart holds the German university and factory system ultimately responsible. Granted that a supply of properly qualified candidates for industrial posts has been achieved at the cost of several thousands of new but relatively unimportant compounds, we shall scarcely hesitate to pay in full this price of admiralty, although we may regret the necessity of supplementing it by some £125 for the new 18-volume edition of the monumental Beilstein After all, it falls only to a Lavoisier to achieve originality in chemical science, and yet to discover "no new body, no new property, no natural phenomenon previously unknown."

A work of the nature and scope of Prof Stewart's book must inevitably raise many interesting problems concerning teaching and investigation in organic chemistry at the present time. One of the most important of these considerations is the trend of contemporary research It is striking that the old lament over the neglect of organic chemical research should have been succeeded within the space of a few years by a growing criticism of the alleged tendency towards over-indulgence in formal and comparatively barren investigations, which, in Prof Stewart's words, do not "lead to a fresh avatar of the subject." This state of affairs is attributed in part by Prof. Stewart to a transference of the more original minds from organic chemistry, which, on the theoretical side, "is apparently resting on a dead centre of perfection," to the more mobile and spectacular fields of inorganic chemistry and radioactivity. Is it not due also in part to the nature of the Ph.D system, which accounts largely, although by no means wholly, for the greatly increased output of research in recent years ?

The Ph D. degree is granted for organised research under supervision, and is the hall-mark of the potential rather than the mature research worker. The provision of appropriate subjects for research, which shall yield results suitable for publication within a limited time, is often a matter of considerable difficulty; and there is little doubt that much of the formal work appearing in the current journals is an outcome of conditions which often compel an aspiring junior investigator to play for safety. Adjudicators of Ph.D. theses would do well to consider to what extent a bold conception, backed by competent practical work, may be allowed to weigh against a succession of negative results · a sympathetic handling of such cases would do much to lessen the formality of

research work conducted under the ægis of the Ph D. system

Prof Stewart does not despair of the future of organic chemistry. Like many of his contemporaries, he foresees the acquirement of renewed inspiration and vigour from a return to the study of compounds produced by natural methods in plants and animals. There is, indeed, much to be said in favour of an increasing diversion of the activities of organic chemists to investigations dealing with the manifold chemical problems presented by living matter

"For example, nme-tenths at least of our laboratory reactions he outside the temperatureligarts under which the plants and the animals exist, yet plants and animals succeed in producing quite considerable yields of certain materials which we can obtain in the laboratory only with some difficulty It seems not impossible that a study of reactions which can take place at ordinary temperatures and in the absence of violent reagents, might open up an entirely fresh line of development in organic chemistry Our increased modern knowledge of catalysts and their action makes this field much more promising than it once was, and the possibilities involved in the use of colloidal reagents need only be mentioned in order to suggest lines of investigation which could hardly prove unfruitful There is one obvious advantage which would be conferred by a return to Nature such as is here Research of this kind would clearly centre round the very simplest of our known reactions—the addition or removal of the elements of water. for these two processes evidently play a prominent if not a predominant part in the natural syntheses. Thus some incentive would be given to a study of the mechanism of our simplest chemical changes, a subject which would certainly repay a good deal of investigation."

It is nowadays a generally accepted dictum that vitality in teaching is dependent upon a correlated appreciation of contemporary research In organic chemistry, the delicate equilibrium which exists between teaching and research has been disturbed in recent years by several influences, and not least by the remarkable growth of the subject. It is no longer possible to offer a fairly complete conspectus of this branch of chemistry to the advanced student. Excessive teaching, like excessive formalism in research, inculcates the spirit of Beilstein and represses that inborn spirit of adventure which is as essential in the scientific investigator as in the Arctic explorer. Wherefore, the wise teacher selects certain fields of work for special treatment, fixes a judicious limit to the number of his lectures and to the amount of information which he strives to impart, and gives discreet indications of subjects suitable for independent reading and study. Such

a teacher will approve of the plan of Prof Stewart's work, the general character of which will already be familiar to him

The first volume of the new edition contains a treatment, designed for third-year students, of a series of themes which the author regards as a convenient basis for discussing the recent investigations presented in the second volume. themes are not necessarily concerned with recent work, for example, the development of the chemistry of the menthones and other monocyclic camphors has not been traced much beyond 1907. The second volume, to which the title is more particularly applicable, will be appreciated by honours students and research workers who seek compact and up-to-date accounts of carbohydrates, sesquiterpenes, alkaloids, anthocyanins, chlorophyll. depsides, organo-alkalı compounds, abnormal valency, theories of the natural syntheses of vital products, and applications of electronics to organic chemistry The selection of themes for a work of this kind must obviously be determined to a large extent by the particular interests and predilections of the writer; the general tenor of the author's introductory remarks, however, would seem to call, inter alia, for a consideration of recent work on hormones and on the application of catalytic methods in the production of simple organic compounds fruitful field of modern organic chemistry has been harvested by a multitude of labourers, much of the grain necessarily remains in ear, but upon his thrashing-floor of 769 pages Prof Stewart has rendered yeoman service in purging a good deal of it from the superabundant chaff.

JOHN READ.

# Structure of Tropical Cyclones.

Tropical Cyclones By Dr. Isaac Monroe Cline Pp. 301. (New York. The Macmillan Co, 1926.) 21s net.

BEFORE we can explain the origin and life cycle of a tropical cyclone, it is essential that we should have accurate pictures of the air motion at all levels throughout the storm. Dr. I. M. Cline, of the U.S.A. Weather Bureau, endeavours in the work before us to give such a picture for all tropical cyclones that have moved in over the Gulf of Mexico and South Atlantic regions during the twenty-five years 1900–24.

The number of observing stations falling within the storm area was always small, but, with hourly readings of the ordinary meteorological instruments available, each was made to turnish the equivalent of a number of simultaneous scattered observations, by plotting the hourly readings on a single diagram of the cyclone divided into four quadrants. These quadrants were fixed with reference to the instantaneous movement of the cyclone and not according to the points of the compass—thus the two front quadrants lay on either side of the line of instantaneous motion and were separated from the rear quadrants by a line drawn perpendicular to the line of instantaneous motion. With such an arrangement the observations from each station when plotted form a chain running across two or even three quadrants of the cyclone.

The distribution of surface winds, of upper winds deduced from the motion of clouds, and of rainfall, was obtained with a reasonable amount of detail for sixteen storms; and the diagrams, constructed in the manner just described, themselves suggested an appropriate grouping as follows.

- Large cyclones (diameter more than 450 miles) that continued to advance after moving inland.
- II Small cyclones (diameter 300-450 miles) that continued to advance after moving inland
- III Small cyclones which did not continue to advance after moving inland

The observations from all the cyclones in each of these groups were plotted as though they had been made in a single storm In this way three composite cyclones, representative of the three groups, were sketched in great detail. Justification for the method adopted for plotting the hourly observations was then apparent, for where the chains of observations for two different cyclones crossed, the wind directions nearly always agreed well. It seems scarcely possible to improve upon this method of making the most of a limited number of observing stations, and no other part of the world liable to tropical cyclones can at present supply a closer network of well-equipped observing stations near sea-level. The value of the work is greatly enhanced by the publication in full of all the hourly observations.

We may now consider the diagram representing the winds and rainfall in cyclones of Class I. The wind system here depicted differs greatly from the symmetrical whirl around the small central eye of light winds and lowest barometric pressure that one is led to expect from general descriptions of the tropical cyclone. It is only in the two left-hand quadrants, where on the average the winds outside

the 'eve' are least strong, that such motion is found a large part of the front right quadrant contains winds flowing in towards the centre, while in the right rear quadrant the motion is almost entirely parallel to the direction of motion of the centre A considerable amount of convergence results from these last two currents, a little in advance of the line separating the two quadrants, and the distribution of hourly rainfall shows a maximum hereabouts, with a general absence of ram in both rear quadrants as though the right rear quadrant contains a current of air which, ascending and turning to the left, condenses its moisture so as to supply most of the rainfall in the evelone

In the case of the small travelling cyclones (Class II) the above general description applies equally well: the similarity between the wind systems and the position of the region of maximum rainfall is striking and suggests that the observational material used has been sufficiently accurate and abundant to reveal for the first time essential features of tropical cyclones—at least of those passing through this region along normal paths.

Turning now to cyclones of Class III, that is to say, those which failed to pass on inland, the distinctive features of the winds in the two right-hand quadrants are no longer evident, and the cyclone as a whole has much more the character of a circular eddy At the same time the precipitation is no longer localised, the amount in the rear half being at least equal to that which occurs in the front half These storms were found to die out before long, or to move away as very weak, illdefined disturbances. The winds considered so far have been those observed at the surface, and those deduced from the motion of clouds of low and moderate elevation; the convergence between the winds in the right sectors that is so marked at the surface appears to diminish at higher levels, a fact which is in accordance with the suggestion made above that the winds that enter the right rear sector and supply the bulk of the precipitation turn to the left as they ascend above the opposing barrier of the winds of the right front sector. The wind at the height of the cirrus clouds (about six miles), so far as may be judged from the scanty observations of the motion of these clouds available, has little or no relationship with the winds in the lower layers, and shows little regularity. It appears that the direction of motion is often about the same as that of the cyclonic centre in the large travelling cyclones, whereas in the smaller travelling storms it is generally across the cyclone from

left to right — For those cyclones which ceased to advance, left to right movements also predominated, the number of cases where the motion had a component opposite to that of the centre was greater than for the other two classes of cyclone

There is little to add to the above summary, which includes the most striking features of the storms revealed by this new method of analysis. It must be remembered that the results obtained do not necessarily apply to the cyclones of other tropical regions, or to the earlier stages of the same storms It may be assumed that those considered here had nearly all been in existence for several days, they were as a rule approaching the time of their recurve out of the tropical belt of easterly winds into the westerly winds of temperate One would like very much to know the origin of the air that enters the system through the right rear quadrant, but since this would normally arrive from some point between east and south, i e. from the open sea, the construction of trajectories can scarcely be possible, owing to paucity The author was unable to find of observations in the surface temperature records any traces of discontinuity between the converging wind currents, but since both supplies of air must generally have been over warm ocean for many days, this does not prove that they were not in reality of widely different origin when traced sufficiently far back

In conclusion, it may be said that although an explanation is still wanting of the precise mode of origin of tropical cyclones, a notable step forward has been made—Dr Cline is to be congratulated on having produced a collection of facts which must prove indispensable to anyone seeking to provide such an explanation.

E. V. Newnham

# Psychology of Mental Imagery.

Les risions du demi-sommeil (hallucinations hypnagogiques) Par Dr. Eug-Bernard Leroy (Bibliothèque de philosophie contemporaine) Pp. xv + 132. (Paris: Félix Alcan, 1926) 12 francs

THIS is a small book, but an important contribution to the study of mental imagery in general, and in particular of that kind of imagery which is experienced in the hypnagogic state. Many people, just before falling asleep, or waking fully from sleep, pass through a stage in which they have visual (and sometimes other) imagery of a very striking kind. The fact has been known and reported upon in psychological literature for something more than a century; but the interesting problems to which it gives rise have for the most part been cursorily and not very satisfactorily dealt with Dr Leroy limits himself to a psychological treatment of his subject, and puts his book before the public as a contribution to the psychology of hallucinations and dreams. For the physiological and pathological aspects of hypnagogic imagery he believes that methodical experimental work is still greatly needed; but in the present investigation he relies mainly upon his own experiences and those of persons whose sincerity he is able personally to guarantee

In a very careful and detailed description of 'hypnagogic visions,' for which he has drawn upon the available literature as well as cited a number of original accounts, Dr Leroy passes in review and compares with them after-images, phosphenes, entoptic glow (Eigenlicht), and the like He then turns, in a second chapter, to an examination of the conditions of emergence of these images This chapter is closely reasoned and particularly well documented It leads to the important conclusions that such images are frequently hindrances to thought (which may go on in this transition stage between sleeping and waking), and that an appeal to the unconscious to explain their occurrence is "to invoke the deus ex machina of embarrassed psychologists." Psychoanalysts will scarcely agree with this opinion, and, indeed, Dr Leroy omits altogether any consideration of psychoanalytic doctrine from his work.

Chapter in is concerned with the interpretation of hypnagogic imagery, which is here compared with normal memory imagery, the eldetic imagery reported by Jaensch, hallucinatory imagery and illusions. The characteristic most insisted upon is the involuntary nature of the hypnagogic images. The will can only influence them indirectly, and they require for their development a certain degree of psychic automatism.

In the final chapter, hypnagogic images are compared with those of the dream, and the transition from the half-waking state to that of sleep is discussed. The images are spectacles at which we passively assist; the dream is an adventure in which we take part.

Over and above the interest attaching directly to these different kinds of images in themselves, there is the greater interest in the different mental states which give rise to them. In theory and in practice the question is one which concerns both pure psychologists and psychotherapists; and Dr. Leroy's book will be read by both with profit.

# Savovard Highlands.

Rambles in High Savoy By François Gos Translated by Frank Kemp Pp. 169 (London: Longmans, Green and Co, Ltd., 1927) 21s net

THIS is a beautiful book, the sepia illustrations alone giving it a delightful character. They are reproductions of photographs, not by the author but by well-known Alpine photographers, including his celebrated father. Émile Gos There are two prefaces by climbing friends, Mr Geoffrey Winthrop Young and M F. Regaut, president of the French Alpine Club, who was also the commander of the Alpine Corps, the famous 'Diables Bleus,' in the War It may be that many would prefer a simple preface by the author himself, but that feeling is tempered by the pleasure which anything written by Mr Young on his favourite subject must convey, and by the fact that the camaraderie of the War, in which the author served in the Alpine Corps under M. Regaut, has evoked highly interesting remmiscences of the great struggle from the latter in the course of his preface.

As its title implies, climbing in the chain of Mont Blanc is not the main subject of the book; it is more a description of walks and minor climbs in the foothills of that great chain, week-end rambles among them, from Geneva as base of operations. For anyone living at Geneva, or paying long visits to that delightful city, it is indeed ideal. For, as Mr. Young so admirably says, "We cannot think of Savoy as only glacial peaks and passes, nor as . . . alps of summer flowers, nor yet only as romantic villages bright with festal costumes and musical voices. We think of it in single pictures which combine all three simultaneously."

How delightful many of these rambles can be! For they usually culminate in the arrival at the top of some eminence such as the Salève, the Môle, the Brezon, the Aravis, or the Col d'Anterne, from all or any of which we see, growing in immensity and wonder and clearness of detail as we approach the closer, the whole or greater part of the great chain of the most beautiful snow mountains in the world, culminating in the exquisite white dome of Mont Blanc itself, the highest peak of the European Alps, 15,782 feet above the sea. M. Gos writes in a very entertaining manner, and has given us a volume which it will ever be a pleasure to open. Moreover, the author has not suffered from his translator, who has maintained the author's own atmosphere quite remarkably well, and happily gives us the numerous poetic quotations in the original French.

A. E. H. TUTTON.

#### Our Bookshelf.

Economic Biology for Students of Social Science. By Dr Philippa C Esdaile Part 1 Harmful and Useful Animals Pp xv+175 (London: University of London Press Ltd, 1927) 7s 6d. net

THE author rather seeks to disarm criticism by stating in the preface that much ground was of necessity left untouched, and that the critic who cavils at this restriction must be even more ambitious than herself! It is not so much the ground which has not been covered, but the whole point of view from which the book is written which calls for criticism It deals briefly with the structure and life histories of those animal types which students of biology are required to study during their course in social and household science at King's College for Women There are already a number of text-books of zoology which do the same sort of thing, and since this is a specialised course, which has special reference to social science and applied biology, it surely would have enhanced the value of this book if those applied aspects had been dealt with in detail, and the student referred to one of the general text-books for structure and anatomy.

Such important questions as the control of venereal disease, treatment of children for infection with Nemathelmunthes and Platyhelmunthes, and the ridding of houses of insect pests, etc., are not described with any practical detail, and for the average student who does not know where to look for further information, and has little or no general scientific knowledge, the treatment of the subject is too scanty. One feels that a valuable opportunity has been lost of producing a book which might have opened the eyes of social workers, and incidentally of a large section of the general public, to the importance of applied biology. Much might have been done through a text-book for special courses, and by helping the students by a carefully chosen range of reading, but there is not even a bibliography appended. HEB.

Theory of Machines: a Textbook covering the Syllabuses of the B.Sc. (Eng.), A M Inst C.E., and A.M.I.Mech.E. Examinations in this Subject. By Louis Toft and A. T. J. Kersey. (Engineering Degree Series.) Pp. ix +408 (London Sir Isaac Pitman and Sons, Ltd., 1927.) 12s. 6d. net.

ALTHOUGH written primarily as a text-book for students reading for an engineering degree, this volume should prove equally useful to engineering draughtsmen and designers as a reference handbook spanning the gulf which is still sometimes thought to exist between scientific principles and workshop practice. In the first four chapters the authors lay a sound theoretical foundation, and treat such matters as the laws of dynamics and simple harmonic motion with skill and clearness. Their experience as teachers has taught them where the beginner's difficulties generally lie. The rest of the book is concerned with the application of fundamental principles to actual mechanisms in everyday

use, from the simple crank and connecting rod to the gear box and Ackerman steering of a motor-car

On the whole, the ground is well covered, but it is suggested that future editions might contain paragraphs on the reactions exerted by oscillating bodies at their supports, on the properties of the centre of percussion and on the theory of the hammer and pile driver. The theories of toothed gearing and of machine balancing are adequately treated, and the chapter on friction and lubrication, including a discussion of the Michell and ball bearings, is up-to-date.

The book is illustrated with a large number of clear diagrams, while each chapter concludes with a good selection of examples from examination papers and other sources. An appendix on units and dimensions is seriously marred by the astonishing definition of the engineers' unit of mass as the ratio of the weight in pounds of a body to its acceleration in feet per second per second when falling freely; which ratio is stated to be constant.

A. L. RAWLINGS.

Medical Views on Birth Control. By Dr. H. Crichton-Miller, Prof. Leonard Hill, Dame Mary Scharlieb, Dr Arthur E. Giles, Dr. R. C. Buist, Dr. Letitia D. Fairfield, Sir Arthur Newsholme, Sir John Robertson With an Introduction by Sir Thomas Horder. Edited by Sir James Marchant. Pp. xx + 175. (London Martin Hopkinson and Co, Ltd., 1926.) 6s. net.

This book consists of a number of essays by prominent members of the medical profession, with an introduction by Sir Thomas Horder. The latter rightly warns his readers against expecting to find a complete solution to all the problems that have to be considered in association with contraception. The spirit of scientific inquiry has guided the authors, and when personal views are indicated it is quite evident that there is by no means unanimity of opinion. In general, it is recognised that contraception is justified in some circumstances, though one contributor is uncompromisingly antagonistic. To those who seek medical advice on the subject, the question will be a personal one; the general practitioner will therefore find of most interest the chapters on the medical and psychological aspects. The physician has to remember that if he is ever to advise limitation of the family, he must also be prepared to advise a method. Abstinence cannot honestly be recommended, except under conditions which are prohibitive for the average married man and woman. The practitioner will find guidance in the comments and criticisms of other methods given by various contributors.

Standard Methods of the Division of Laboratories and Research of the New York State Department of Health. By Dr. Augustus B. Wadsworth. Pp. xx+704+12 plates. (London: Baillière, Tindall and Cox, 1927.) 34s. net

This book is devoted to a detailed account of the methods used by the division of Laboratories and Research at the Department of Health for the State of New York, situated at Albany, with a branch in New York City and numerous associated

laboratories throughout the State General bacteriological technique, preparation of media and glassware, and diagnosis, for the greater part bacteriological, are fully described, and a large section (326 pp) is given up to the preparation of vaccines and sera. A chapter deals with sanitary chemistry, and at the close of the book a brief account is given of the general organisation of the institute

It is, altogether, a very interesting book and should prove a useful reference to those engaged in public health laboratory work and the manufacture of biological products. One is left with an impression that the institution concerned has developed a high degree of efficiency in routine work, a fact which tends toward making the presentation of the work outlined a little stereotyped.

The Prospective Development of Peru as a Sheepbreeding and Wool-growing Country. By Prof. Alfred F Barker. Pp. xii + 174 + 8 plates. (Leeds · The Author, The University, 1927.) np. PROF. BARKER, at the request of the Peruvian Government, went to Peru in 1926 to study the development of Peruvian flocks and of Peru as a wool-growing country. The present illustrated volume is the report of that visit, with a number of valuable appendices on different aspects of wool. The wool production of the Peruvian tablelands in the high Andes is steadily growing and the number of sheep has doubled in five years. Peruvian wool has many good qualities, and it loses little in scouring because of the cleanliness of the pastures, but the fleece is very light compared with Chilean, Argentine, and Australian fleeces. Prof. Barker discusses the cross-breeding and selection necessary for increase in the weight of the fleeces, and incidentally he points out that the problems involved in these researches make them a valuable field of study in genetics that should appeal to every university. The report is beautifully illustrated, with some of the plates in colour.

The Psychology of Childhood: Normal and Abnormal. By Dame Mary Scharlieb. Pp. xi+194. (London. Constable and Co, Ltd., 1927.) 6s. net.

This little book is by an authority competent to instruct as well as to advise respecting the practical and non-theoretical relationships which should exist between parent and child. Dame Mary Scharlieb with correct intuition speaks of the great burden, yet great honour, of bringing up children, and the necessity of guidance. Parents of all classes will find her conclusions of real help in child-management. Happily, the outlook is not that which prevailed during the War. Those qualified to judge found that the young suffered much from their mothers' privations and anxieties. Children knew neither legend nor fairy-tale. There is a prefatory note by Mr. R. F. Graham-Campbell, a London magistrate, who sees much to commend in a chapter which deals with the action of conscience, the influence of suggestion, and of equable discipline upon juvenile delinquents.

#### Letters to the Editor.

[The Edutor does not hold himself responsible for opinious expressed by his correspondents. Neither can be undertake to return, not to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. No notice is taken of anonymous communications.]

# Cranial Characteristics of Gorillas and Chimpanzees.

In Nature of Feb. 7, 1925, p. 195, Prof. Raymond Dart announced the discovery of a fossil skull of a young anthropoid ape which had been found in a linne-stone quarry at Taungs, Bechuanaland. This discovery brought to light an extinct kind of great anthropoid, which differed from the three living genera—the gorilla, chimpanzee, and orang—in having a long or dolichocephalic skull. After having read Prof Dart's account, Prof L. Bolk, of Amsterdam, drew attention to the skull of a gorilla in his collection which was quite as dolichocephalic as the Taungs skull (Kon. Akad. van Wetensch. Amsterdam, 1925, vol. 28, No 2, p. 1). In the same year, Prof Wingate Todd, of the Western Reserve University, Cleveland, Ohio, informed me that the accepted idea of round-headedness or brachycephaly prevailing amongst gorillas was wrong, several skulls in his collection being dolichocephalic.

In 1926, Dr H. A Harris, of University College, London, examined Lord Rothschild's collection of gorilla skulls, 49 in number, and found that when the shape of the crainal cavity was determined by an exact radiographic method, the head form of the gorilla was highly variable—running from a low dolichocephaly to a high brachycephaly (Amer. Jour. Physic Anthrop., vol 9, p. 157, 1926) The width of the crainal cavity, he found, might be as low as 72 per cent. of the length, or it might be as high as 86 8 per cent., the mean width of all 49 specimens being 79 1 per cent., the intrinsic skull form of the gorilla lying therefore in the upper register of mesocephaly. Thus in the gorilla, which the majority of authorities regard as manifesting a greater structural resemblance to man than any other living form, there is found as wide a range of crainal proportions as is found in any mixed group of human skulls.

As Lord Rothschild's skulls came from widely separated districts, it was possible that the high degree of variability was due to a mixture of local breeds or races. A collection of gorilla skulls, 42 in number, which my friend Dr. N. A. Dyce Sharp has presented to the Museum of the Royal College of Surgeons, shows this is not the case; <sup>1</sup> all the skulls come from one locality, where there can be no question of mixture of races, and the variation in them is just as great as that found by Dr. Harris in Lord Rothschild's collection.

Dr. Sharp was stationed as medical officer in the Ossidinge division of the British Cameroon. In the forest upland of the northern part of this division is found the ultimate distribution of the gorilla towards the west of Africa; Dr. Sharp believes that the habitat of the gorilla extends only a very short distance beyond the Eastern Nigerian frontier. The native villagers of this area hunt and eat both the gorilla and chimpanzee, the gorilla being the more highly esteemed as food. After a village feast the skulls are thrown aside, and it was from the remains of such feasts that Dr. Sharp gathered his specimens. Unfortunately, brains are also valued, and hence some of the skulls were not so intact in the occiput as a

<sup>1</sup> Dr. Sharp's collection was exhibited at a meeting of the Zoological Society on Nov. 15, 1927.

eramologist could desire. Five years ago, Mr. F. W. H. Migeod visited the same area of the Ossidinge district and succeeded in obtaining five skulls of gorillas, which he presented to the Museum of the Royal College of Surgeons, so that I have at my disposal 47 gorilla skulls from the same area on which to determine the variability in size and shape of the skull. The specimens represent both sexes and all ages, from the full eruption of the first permanent molar teeth upwards. The dimensions of the cranial cavity were taken by direct measurements. Dr. Sharp also presented 20 chimpanzee skulls from the same district. They show a much higher degree of uniformity than the gorilla skulls.

In 23 skulls of male gorillas from Ossidinge the mean length of the cranial cavity was 1216 min, the mean width, 95 8 mm, the width being thus 78 8 per cent. of the length, but there was a range from 72 per cent to 88 per cent—from pronounced dolichocephaly to ultrabrachycephaly—The mean cubic capacity of 17 skulls of adult males was 503 cm <sup>3</sup>, varying from 355 cm. <sup>3</sup> to 620 cm <sup>3</sup>. In a local group of gorilla the brain varies in mass just as much relatively as among members of any human community. In 24 skulls of temale gorillas from Ossidinge the mean length of the cranial cavity was 112 2 mm., and the mean width 91 3 mm., the width being 81·3 per cent of the length, but this figure fell as low as 72 per cent. and rose as high as 87 per cent As in human skulls, that of the female is the rounder or more brachycephalic. The capacity of the female skull is much smaller than that of the male—to a greater degree than is the case when human skulls are measured. The mean capacity of the adult female skulls (19 m number) was 425 8 cm  $^{\circ}$ , varying from 370 cm. $^{3}$  to 530 cm. $^{3}$ . The sexual differentiation is more pronounced among gorillas than in any other group of higher primates

The degree of variability in goulla skulls is even more pronounced when external measurements are taken in a manner which gives dimensions comparable with the length and width as usually taken on human The external length varied, in male skulls, from 113 mm. to 155 mm, the mean being 138 3 mm., while the mean width fluctuated between 92 and 101 mm., the mean being 97.2 mm. The width thus varied from 60 per cent. of the length to 79 8 per cent., the mean cephalic index being 66. In female skulls the mean width was 68.6 per cent. of the mean length, the proportion varying from 61.7 to 80.6 per cent. There is even a greater variability in the form of the face of the gorilla. In the Ossidinge breed it varies from being short and wide to long and narrow—a variation of a similar kind being also noticeable in all human communities. The Kivu gorilla, which represents the most eastern distribution of the genus, shows the same variability in form of face.

It is interesting to compare measurements taken on Dr. Sharp's collection of chimpanzee skulls with those taken on gorillas from the same district. In 10 male chimpanzee skulls the cranial capacity varied from 325 cm.3 to 430 cm.3, the mean being 368 cm.3. The range was thus 105 cm.3 compared with 265 cm.3 m the male gorilla skulls. In female chimpanzee skulls the capacity varied from 330 cm.3 to 395 cm.3, the mean being 358 cm.3, and the range 65 cm.3, compared with 160 cm.3 in the corresponding group of gorilla skulls. The mean difference between the capacity of male and female chimpanzee was only 10 cm.3, the sexual difference among gorillas being 76 cm.3. The length of the cranial cavity in 10 male chimpanzee skulls varied from 98 mm. to 108 mm, the mean being 105.7 mm., while the width fluctuated between 86 mm. and 92 mm., the mean being 89.3 mm. The mean proportion of width to length was 84.5 per

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cent., the chimpanzee being thus markedly brachycephalic. The index or proportion varied from 796 to 90 1, a range of 10.5 units, as compared with 16 1 units—the range of variation in the skulls of male gorillas. If external measurements are compared, the skull of the male chimpanzee has a width which is 75 per cent. of the length, but it may fall to 71 or rise to 78 per cent. In female chimpanzee skulls the internal length varies from 98 mm. to 114 mm, and the width from 86 mm to 93 mm., the mean length being 1055 mm, the mean width, 888 mm. The mean width is thus 84.1 per cent. of the mean length, but the proportion varies from 789 to 91.8 per cent. Thus there is no significant difference between the form of the cranial cavity of the male and female chimpanzee, whereas in gorillas the difference is of a decided character.

One other point relating to the differentiation of species amongst gorillas and chimpanzees may be mentioned here. Lord Rothschild has directed attention to the external characters which distinguish gorillas of one district from those belonging to other districts. There should be no hesitation in distinguishing a gorılla of the western frontiers of Uganda from one native to the eastern frontier of Nigeria, but when I have sought in skulls for recognition marks, I have hitherto failed to find any certain distinctive and constant mark. It is quite true that it is possible, in a certain proportion of cases, to distinguish the skull of a Kivu gorulla from those from other districts, but for one which can be picked out from a miscellaneous group there are four which cannot be identified, except by their labels. I am sure Lord Rothschild is right in dividing both gorillas and chimpanzees into local races or subspecies, but the degree of differentiation has not yet affected the cranial or dental characters to a degree which permits the racial identification of the majority of individuals. ARTHUR KEITH.

Royal College of Surgeons, London, W.C.2, Dec. 5.

#### Consistent Dynamical Units in Solar Radiation.

SIR NAPIER SHAW—facile princeps, in the group of disheartened but persistent advocates of reform in our heterogeneous units of weight and measurement—proposes in volume 1 of his "Manual of Meteorology" a consistent dynamical unit based upon the C.G.S system for records of solar (likewise terrestrial) radiation. The unit he suggests is the kilowatt per square dekametre per minute, that is, 0 0143 of a gram calone per square centimetre per minute. It will perhaps be granted even by those who favour the retention of the calone that the minute is not a desirable interval; and that it will be better to use the hour. Thus we are in agreement with electrical measurements of light and power. A gram calorie being approximately 4:183 joules, it will require 860.300 calories to equal 1 kilowatt hour.

This unit equals 3411 British Thermal Units, and it is worth noting that there is constant hability to confusion here with British Trade Units. Some teachers still prefer to express work in foot-pounds, and energy output in horse-power, but even these must grant that the horse is fast disappearing from highways and is even replaced on farms by tractors. Hence in a few years this unit h.p. (0.746 kilowatt) will go the way of barley corns, once sub-multiples of the mich.

It would seem to those desiring simpler fundamental units that Sir Napier Shaw has a strong case when he says that the gram calorie per square centimetre per

minute "is only tolerable when radiation measurements are regarded as belonging to a separate physical compartment and the transformations of energy in the atmosphere which are the natural results of radiation are ignored, although the comprehension of those transformations is the very purpose of the measurement of solar and terrestrial radiation so far as meteorology is concerned."

The use of the new unit has been opposed on two grounds; namely, (1) that uniformity is desired; and (2) that future measurements may be easily compared

with older results.

It will appear below that uniformity is best secured by a unit which is not confined to heat capacity alone. As for the second objection, this would be a case of bringing the colours back to the regiment instead of bringing the regiment up to the colours. The old values are easily read, remembering that one calorie per square centimetre per minute equals 1·161 kilowatt hours per square dekametre. (The square dekametre is 1076 square feet.)

A good start in the use of the new units has been made by Dr. H. H. Kimball (Monthly Weather Review, April 1927, p 157), who has assembled values for different observatories. As the table may not be generally known, it is here reproduced.

AVERAGE ANNUAL AMOUNT OF SOLAR ENERGY RECEIVED ON A SQUARE DEKAMETRE OF HORIZONTAL SURFACE IN KILOWATT HOURS

Habana Lincoln Mt. Weather Washington		•	184,488 160,906 148,824 145,403		169,462 175,696 174,043 83,133
Madison Toronto			139,523 106,460 97,856	South Kensington Stockholm	78,569 79,267 70,296
Chicago	•		89,424	Sloutzk	10,200

ALEXANDER McADIE.

Blue Hill Observatory, Readville, Mass.

#### Absorption of X-rays in Various Elements.

In a recent letter to Nature (Nov. 12, p 695), Dr. E. Jonnson concludes from his measurements on the absorption of X-rays over a wide range of wavelengths that the so-called 'jump'  $\delta_K$  of the absorption coefficient in passing the K-absorption limit is given by

$$\delta_K = \frac{E_K}{E_{L_1}},$$

where  $E_K$  and  $E_{L_1}$  are the energy levels corresponding to the K- and the  $L_1$ -levels respectively. Mr. Johnson does not define  $\delta_K$ , but I assume that, in accordance with current practice,  $\delta_K$  is the ratio of the fluorescent absorption coefficient infinitely near to, but on the short wave-length side of, the K-limit to that coefficient infinitely near to, but on the long wave-length side of the K-limit.

A relation substantially identical with this was suggested by the writer some years ago (F. K. Richtmyer, Phys. Rev., vol. 23, p. 292, Feb. 1924). But it is difficult to harmonise this suggestion with our present concepts of atomic structure. If we accept the usual quantum-photoelectric picture of the absorption of X-rays, it follows that this ratio  $\delta_K$  is numerically equal to the ratio of the number of  $(K+L+M\ldots)$  photoelectrons to the number of  $(L+M\ldots)$  photoelectrons expelled by a beam of X-rays of wave-length  $\lambda < \lambda_K$ , where  $\lambda_K$  is the wave-

length of the K-limit. If, then,  $\delta_K = \frac{E_K}{E_{L_1}}$ , it follows at once that the relative numbers of K- and of L-photo-electrons must be independent of the relative numbers of

K- and of L-electrons in the atom. This, if true, would be a very surprising result, for it is more or less obvious, a priori, that the probability of the photoelectric expulsion of an electron from a given group should depend, in part at least, on the number of electrons in that group. Several different investigators have derived expressions on theoretical grounds (for a summary, see F. K Richtmyer, Phys. Rev. vol 27, p. 1, 1926 Also abid., Dec 1927) showing that the probability of the photoelectric election of an electron from a level in which the binding energy is E and containing n electrons is proportional to  $nE^2$ —a prediction which, however, agrees only qualitatively with experiment.

A precise experimental check of any theory of the absorption of X-rays is rendered very difficult by the fact that, of necessity the measured values of absorption coefficients must include scattering at present no means, either experimental or theoretical, of determining, with anything like acceptable accuracy, the scattering coefficients at various wavelengths by means of which to determine from the measurements the actual values of the fluorescent absorption coefficients As an illustration of the ambiguity in measuring  $\delta_K$  may be mentioned the fact that  $\delta_K$  for silver is either 6.4 or 6.0 according as the (mass) scattering coefficient is taken as 0.8 or 0.2. For gold, the respective values of  $\delta_K$  are 6.4

However, there is no reason to reject an experimentally determined relation just because it happens to conflict with theory. Accordingly, the full text of Mr. Jonnson's paper will be awaited with interest

F. K. RICHTMYER. (Cornell University.)

Gottingen, Nov. 21.

#### The Mechanism of the so-called 'Posterior Sucker' of a Simulium Larva.

IN NATURE of July 30, p. 154, Dr. R. J. Tillyard criticised my letter that appeared in the issue of April 23, p. 559, under a misapprehension. The delay in reply has been due to the fact that until my arrival ın Edinburgh I was not able to consult Tonnoır's paper in Ann. Biol. Lacustre, 11, p. 163 My reference to it in the first letter was based on information contained in Dr. Puri's paper (Parasitology, 17, pp. 295-369;

My object in writing my letter in Nature of April 23 was not to lay claim to a discovery, but to lend support to Tonnoir's views regarding the function of the so-called 'suckers' of the Simulium larvæ. The publication of Dr. Puri's paper showed that the work of Tonnoir was not fully accepted, and I considered that further remarks on the subject were desirable. It was a matter of great pleasure to me that my observations corroborated Tonnour's account in all essential

respects.

Dr. Tillyard has objected to my use of the word 'strong' for the muscles of the posterior 'sucker,' and in support of his arguments has referred to Dr. Puri's figure (pl. vin, fig. 10). I wonder if Dr. Tillyard took the trouble to study carefully this figure and to understand it from the account given by the author. Besides mentioning a number of slender muscles, Dr. Puri (p. 321) points out that "a very stout muscle originating dorsally from the anterior end of the seventh segment, and dividing into two strands, is also attached within this space." Moreover, while discussing the action of the posterior appendage. Dr. Puri (p. 311) says that "my observations, however, show that there are fairly strong muscles connected with the centre of the disc," etc. (Italics are mine.)

In support of his view regarding the function of the sucker' Tonnoir has said, "La dissection montre, d'ailleurs, qu'il n'existe pas de faisceaux musculaires destinés à la formation de cette coupe." Dr. Tillyard justifies this statement by pointing out that "Tonnoir had the blepharocerid larva in mind (on which he was working at the time) when he wrote" this. In his paper Tonnoir gives no indication of this fact, and, even if it be so, to me such comparisons between the structures of two different organisms of a very different build seem misleading.

There is one more point to which I must refer here. I have described an abnormal mode of progression and not "the true method of progression." The larvæ were allowed to crawl on a wet slide and the progression was effected, under the conditions, without the help of the posterior appendage. In a letter to NATURE I could not discuss my observations in detail and I thought it appropriate to illustrate the salient points by the photograph published on April 23. I hope to discuss in detail, at some later date, the function of the organs of attachment in the fauna of torrential streams. SUNDER LAL HORA.

Zoological Department, University of Edinburgh, Nov. 14.

#### Partial Transit of Mercury in May 1937.

THE older text-books indicate a transit of Mercury on May 11, 1937. Thus, Rev. S. J. Johnson, in "Echpses and Transits in Future Years" (1889), p. 6, says: "Mercury on the sun from 8 h morn. to 9.2 h. approximately." On the other hand, Prof. S Newcomb, in his paper on transits of Mercury in vol 1 of Papers of the American Ephemeris, describes the event as a near approach. It does not appear, however, that this statement was the result of accurate computation; it was merely an inference from the large diagram of transits contained in the paper.

I have lately made a computation from Newcomb's tables of the sun and Mercury; I obtain the result that, while there will be no transit in the northern hemisphere, a portion of the planet will encroach on the sun as seen from some southern stations. time that I chose for computation was May 11.37755 U.T. The actual least distance of centres was a few minutes earlier. I obtain true heliocentric longitude of Mercury referred to mean equinox of date 230° 12' 12" 86 latitude – 19' 15".81, log. radius vector 9 6575860. True longitude of sun 50° 15' 23".78, latitude + 0 07", log radius vector 0.0044402; true semidiameter 949" 84. Least distance of centres (geocentric) 957" 96. The apparent least distance is 1" 65 greater through differential aberration Since the differential parallax is 7'' 1 and Mercury's semidiameter 6''.0, there is an overlap at the point of greatest phase of 13''.1 – 8''.12 – 1''.65, or 3''.33. If the tabular places are exact, there will be a small encroachment of the planet on the sun as seen from Port Elizabeth, but probably not from Cape Town. The occasion will be a favourable one to search for a ring round the outer portion of Mercury, due to refraction in its atmosphere. In England the least distance of Mercury from the sun's limb will be about 6", so it should be possible for spectroscopists to see it projected on the chromo-

Such partial transits of Mercury are very rare, occurring only once in several centuries. When they occur, we get two May transits twenty years apart; thus there is another short transit in May 1957, this time at the sun's northern limb. It happens that the other rare event of two November transits at an interval of six years also occurs this century, in 1993 and 1999. In consequence, the number of transits in the century, fourteen, is slightly above the average.

In the course of this work I detected an error in the Nautical Almanac for 1878, p. 402; the least distance of centres of sun and Mercury should be 4'47" 4, not It is well to note this, as it is likely to confuse those who are using the 46-year cycle to predict the circumstances of future transits. I used methods of this kind in my paper on transits of Mercury in the *Observatory* for 1894, p. 394 I there obtained 16' 1" as the least geocentric distance of centres in 1937; this estimate took no account of perturbations, but its close agreement with my present more careful result serves as a check on the latter.

A C D. CROMMELIN

#### Mathematical Theory of Relativity.

THOSE results in the mathematical theory of relativity that have received experimental confirmation are connected with problems that might be classified as the single-line type. These problems are in the same category as those discussed in particle dynamics and

their analogues in geometrical optics.

When, however, we come to problems involving a congruency of lines, logical difficulties arise. It seems clear that we can no longer identify any one of the fundamental co-ordinates with 'time' Thus, consider the question of 'volume.' In the classical theory the element of volume is invariantive. In the case of a four-dimensional continuum, it is the fourfold element that is invariantive, whereas the threefold element is defined by the four components of a tensor.

Now, taking the four-dimensional continuum, the ground-form of which is given by the equation,

 $ds^2 = dx_4^2 - dx_1^2 - dx_2^2 - dx_3^2,$ 

we readily obtain a group of a type similar to that of the rotations about a point in Euclidean geometry, which forms the basis of the treatment of the angular velocities of a rigid body. This, however, simply provides us with one fourfold continuum suffering displacement through another, which is not exactly what is required. We have, in fact, introduced a fifth variable, namely, the parameter by which the infin-tesimal transformations of our group are defined. Thus a supplementary relation, preferably of a differential type, is needed to define our moving system, and this must be invariantive in character. The abovementioned parameter will then furnish a time measure for the system as defined. It seems that in only some such way can we provide a logical geometrical picture of rotation, which is an undoubted physical pheno-

At present difficulties arise through the necessity of using the old technical nomenclature in connexion with the new ideas, and thus often for purposes for which it was not strictly intended. In the case of the historical dispute concerning the measurement of 'force,' the difficulties were eventually dissipated by the emergence of the concepts of 'momentum' and It may be anticipated that something similar might happen with regard to the new theories.

Einstein has lately indicated that he has not found the new differential geometry any more capable of giving the required generalisation of the electromagnetic equations than the older Riemannian geometry, though the former was introduced with this purpose in view. May it not be that too close an analogy with Maxwell's equations has been contemplated? Thus one would suggest the introduction of a time measure for the electromagnetic field by some such general method as indicated above, together with some compensating addition to the set of equations.

J. Brill.

#### The Oogenesis of Daphnia by Intra Vitam and Post Vitam Staining.

RECENTLY the claims of neutral red as an intra vital stain for the Golgi bodies have been urged by

Dr. Parat and his pupils.

Daphnia is easily stained intra vitally in weak solutions of neutral red, the stain colouring these animals bright pink in a few hours. Janus green solutions also work perfectly on such fresh-water crustaceans.

We have found that the growing oocytes of Daphnia exhibit bright red granules after staining in neutral red. In the gland and gut cells also, red granules are conspicuous. The youngest oocytes and oogonia do not exhibit such red granules, the latter appearing at

the time of yolk formation.

Daphnid ovaries fixed in Champy's fluid and stained in iron alum hæmatoxylin show empty vacuoles, with a chromophile cortex, which correspond in position and size with the neutral red granules of the intra

vitally stained specimens.

These vacuoles are merely the familiar yolk spaces within the Golgi bodies as described by Ludford, Brambell, the present writers, and many other authors. The dictyosomes or Golgi bodies of the oogonia before the inception of yolk formation stain pink in neutral red, and it is only when the yolk spaces are formed that their acidic contents stain bright red in neutral red.

The mitochondria stain green in Janus, and occupy the usual position in the early and growing eggs.

These results may be confirmed by the Nassonow and Da Fano methods, although the latter causes much shrinkage, and is extremely capricious on crustacean material.

With the assistance of Miss Kennelly, we have tried these stains on Limnæa and certain other fresh-water The neutral red will stain a Limnæa bright pink in a few hours, and the molluses appear to

live quite happily in this condition.

We have been unable to confirm Mme. Karpova's claims as to a 'vacuome' in mollusc spermatocytes. On the contrary, neutral red vacuoles only appear during oogenesis, as already described in Patella and Limnæa by Ludford, Brambell, and one of the present ANNIE GLENDON HILL.

J. Bronte Gatenby.

Zoological School, Trinity College, Dublin.

#### Variation of Intensity Ratios of Optically Excited Spectrum Lines with the Intensity of the Exciting Light.

THE principle referred to by Prof. Wood in his letter to NATURE of Nov. 19, that the product of a two-stage absorption increases at first as the square of the intensity of the light, that of a three-stage absorption as the cube, and so on, is evidently capable

of wide application

The necessary data for the examination of the photographic action from this point of view have now been obtained at this Observatory, where the principle was recognised some time previous to its statement by Prof. Wood (see *Proc. Roy. Soc. Edin.*, 47, p. 47 footnote; 1927). The results show a striking similarity to those found by Prof. Wood for mercury vapour. The latent image (in so far as it is developable) is made up for the most part of a slowly developing image resulting from a two-stage absorption process, and of a rapidly developing image formed by absorption in three or more stages. By an extension of the principle to the effects of varying the exposure time, the emissions as well as the absorptions may be examined; in this way the three-stage absorption product is found to develop readily only when accompanied by one intermediate emission—unless this emission occurs, the product is a so-called reversed' grain

It may be noted that while grain counts of fully blackened grains refer to both the two stage and the three or more stage absorption images, counts of grains containing one or more 'nuclei' after partial development refer to the three or more stage

absorption product only.

These results, if accepted, would place the photographic action among the phenomena of phosphorescence.

E. A. Baker.

Royal Observatory, Edinburgh, Nov 22.

#### Misleading Uses of the Term 'Self-Adaptation.'

May I be permitted to direct attention to the use of loose terminology that occurs all too frequently even in some important scientific articles? particular term that I refer to is that in which plants and animals are said to have adapted themselves to some particular environment, etc.

Thus in an article in NATURE of Nov. 26, p. 786, giving the substance of a paper read by Dr. C. M Wenyon to the Royal Society of Edinburgh, flagellates are said to have adapted themselves to life, etc., and this expression is used in the article no less than three

Such expressions as animals adapting themselves, and shade-loving plants, etc., and even the term mimicry, are highly undesirable, though the last term is far too well established for any protest to be effective now. The reason why they are undesirable is that they savour of anthropomorphism, and in these days when one hears so much about natural selection from all quarters, it is imperative to guard scientific terminology most carefully.

These expressions, of course, do not cause any misconception in the mind of the trained scientist, but they are too frequently copied in text-books, elementary and otherwise, and there do a great deal of harm by giving the young student and the lay reader a totally wrong impression. Again, it becomes a very difficult task for the teacher to discourage the use of expressions of this kind amongst his pupils when they

are used by leading authorities.

Such is the desire of the everyday citizen for scientific knowledge at the present time, that no scientific writer is free from the possibility of having his articles appear in a popular form in general literature; the responsibility for accuracy on his part is therefore great.

A. G. LOWNDES.

Marlborough College, Wilts.

#### Regularities in the Spark Spectrum of Silver.

ACCORDING to the theory of Hund, the fundamental terms of the spark spectrum of silver would consist of a deep  ${}^1S_0$ -term (combination  $d^{10}$ ) with metastable triplet and singlet D-terms ( $d^9\ s^1$ ). These would combine with a set of triplet and singlet F,  $\overline{D}$ , and Pterms  $(d^9 p^1)$ .

I have been able to identify the fundamental triplet and singlet D-terms, and the second set of terms. Higher Rydberg sequence to the fundamental D-terms has also been obtained. It has thus been possible to calculate the approximate value of the metastable D-terms. The deepest  $^3D_3$ -term has a value of about 138,000, corresponding to an ionisation

potential of 17 volts, the consecutive differences being  $1577(^3D_3 \cdot ^3D_2)$ ,  $2999(^3D_2 \cdot ^3D_1)$ , and  $2306(^3D_1 \cdot ^1D_1)$ The arc spectrum of silver is a purely doublet

spectrum, the metastable inverted D-terms which are such prominent features of the analogous metals-copper and gold being either totally absent or failing to occur under the usual conditions of excitement. The fundamental  ${}^{1}S_{0}$  will have thus a much higher value than  ${}^{3}D_{3}$ . For Cu<sup>+</sup> the corresponding value has been calculated by Shenstone to be 22,224. Taking the corresponding value for silver to be 40,000, the ionisation potential of Ag+ comes out to be about 22 volts, subject to the approximate nature of the assumptions made in the calculation

K MAJUMDAR

Physics Department, Allahabad University, Allahabad, India, Nov 3.

#### Solution of the Equation $\sin \theta/\theta = c$ .

MAJOR A. E. LEVIN (NATURE, Nov. 26) points out that the usual solution of the above equation by the method of successive approximations is more simple than that which I gave in NATURE of Oct. 1. The expression which I gave is only intended as a first approximation, and as such should only be compared, if comparison is necessary, with the first approximation  $\theta_a = \sqrt{6d} = \sqrt{6(1-c)}$ , in the method he

If such comparison be made when 1/c = K = 1 072502 and K=1 5707963, my expression gives errors + 5′ 32″ and + 1° 6′ 49″, whilst  $_{1}\theta_{a}$  gives errors - 22′ 48″ and -5° 23' 54", the true solutions being 36° 52' 12"

and 90°.

It will be seen that over this range the relative error resulting from the use of my expression is about one-fifth of that with the expression  ${}_1\theta_a$ . This meets that part of Major Levin's letter that refers to my original remarks, which I confined to the range  $0^{\circ}$  to  $5^{\circ}$ .

There are, however, other advantages that make my expression worth consideration as a first approximation. Thus, if c = 0.1909860 and d = 0.8090140, my expression gives the answer with an error  $+2^{\circ}17^{\prime}49^{\prime}$ an error that can be removed by a further stage of approximation, the true answer being 150°. V. NAYLOR.

H.M. Dockyard School, Devonport.

#### Calendar of Discovery and Invention.

In this week's issue appears the last group of notes of the Calendar of Discovery and Invention which I have had the pleasure of contributing to NATURE during the past year. This calendar has aimed at recalling some of the most important advances in science and some of the principal mechanical inventions, and is supplementary to the Calendars of Scientific and Industrial Pioneers which appeared in 1921 and 1922. In the preparation of these notes I have received assistance from many sources, and I should like to take this opportunity of thanking Dr. W. Clark, Mr. A. Gomme, Mr. B. A. Behrend, Dr. R. T. Gunther, and Sir Charles Sherrington for their kindness in placing information at my disposal. The late Dr. Daydon Jackson also kindly sent several interesting notes, which were included in the Calendar, referring to botany and the Linnean Society. Edgar C. Smith.

Riddleswood, Selcroft Road. Purley, Surrey.

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#### Reform of the Calendar.

THE appointment of a special committee of mquiry into the subject of calendar reform was the natural result of a movement which had been gathering force for some twenty years at least. Before the outbreak of the War, chambers of commerce and other bodies had agreed in expressing a strong desire for amending certain defects and inconveniences in the existing calendar, and on the termination of the War and the establishment of the League of Nations, it was almost inevitable that a matter so largely bound up with the commercial and industrial life of the nations in general should be taken in hand by the League.

The questions involved being concerned with religious as well as commercial interests—especially as regards the growing desire for the stabilisation of Easter—the League's Advisory and Technical Committee for Communications and Transit, which undertook the discussion of the matter, invited the Holy See, the Œcumenical Patriarch of Constantinople, and the Archbishop of Canterbury to nominate representatives to assist the Committee at a meeting held at Geneva in August 1923, and at the conclusion of that meeting a special committee of six (including the three ecclesiastical representatives) was appointed to review the whole situation. The result is the report and its ap-

pendices now before us.1

The Committee had a large mass of material available for discussion. Prior to its opening session, the general secretary of the League had communicated to the various governments and religious authorities a resolution passed by its Advisory and Technical Committee for Communications and Transit, and invited comments and observations which might be of help in the inquiry In addition, the special committee itself distributed a questionnaire to a large number of international, educational, industrial, and other organisations, and at its second session it heard Dr. Adolf Keller, representing a large number of Protestant religious communities, and also many of the chief rabbis of Europe and America. The Committee further received more than 180 schemes for reform from private correspondents. All this material has been very carefully sifted and classified and is set out in three annexes. The first deals with calendar reform in general. The second with the Easter problem, and the third summarises the proposals received under nine main groups

The report itself contains a historical survey of the circumstances leading up to the appointment of the Committee and a clear statement of the chief defects of the existing calendar. The Committee resolved to treat the questions of general reform and of Easter separately, and the report is divided under

these two headings.

As to general reform, the Committee was instructed 'not to consider any changes in existing conditions unless such changes were definitely demanded by public opinion for the improvement

<sup>1</sup> League of Nations, Geneva. London: Constable and Co., Ltd., 1926 and 1927.

of public life and economic relations "Accordingly, all proposals which involved tampering with the year, either as regards its commencement (such as a suggestion that this be advanced to the epoch of the winter solstice) or its length (including proposals to correct a small outstanding error in the Gregorian year, and to obviate difficulties arising from the 365th day by the adoption of a leap week at appropriate intervals, etc.), were ruled out. Full consideration, however, was given to suggestions for equalising the divisions of the year as well as to proposals for rendering the calendar perpetual by introducing a principle of dies non or blank days.

As regards the divisions of the year, suggestions for reform mostly follow one of two courses (treated as three in the report). The first is to modify slightly or readjust the lengths of the present months so as to equalise the quarters; the second is to divide the year into 13 months or periods of four weeks each. The respective advantages and disadvantages of both methods are clearly set out in the report. Regarded from the purely business point of view, and quite apart from any consideration of the great inconveniences which changes must inevitably involve in other respects, the real point at issue is whether the quarters or shorter divisions of time based on the week are of primary importance. The replies to the Committee's questionnaire indicated that the present twelve-months year is in general preferred. The Committee has, however, merely recorded the facts without making any recommendation, though it has directed attention to the growing tendency among private organisations to make use of an auxiliary calendar of their own, especially that based on thirteen four-weekly periods as adopted by the British railways and many American organisations.

Under both of the proposed lines of general reform referred to, the odd day (two days in leap years) over and above fifty-two weeks remains an obstacle to perpetuity in the calendar, and it is strongly urged by many supporters of both systems that such days should be excluded from the regular sequence of the days of the week. This proposal has met with very strong opposition in certain religious quarters, and here again the Committee has simply recorded the facts, though urging a fresh examination by the opposing religious bodies

of the principle of a blank day.

As regards proposals to stabilise the festival of Easter, the Committee is rather more definite in its expression of opinion: and in view of the almost universal desire for this measure of reform, such an attitude is natural. It is pointed out that most of the replies apparently favour the second Sunday in April for Easter Day, but it is suggested as a slight modification of this proposal that the Sunday following the second Saturday might be preferable, so as to avoid the clashing of Passion Sunday and the Feast of the Annunciation which would occur whenever Easter fell on April 8. It is, however, emphasised by the Committee that Easter is essentially a religious festival, and that the approval of the

Churches is needed before the proposed reform can be properly effected. From a perusal of the documents contained in the report, it appears that the authorities of the Eastern and Anglican Churches have already accepted the principle of stabilisation, but require as a condition that the change should take place by general agreement of the Churches. The Roman Church admits that there is no objection to the change on dogmatic grounds, but asserts that such a departure from ancient tradition and custom, even if the change were demanded by the general good, could only be considered on the advice of an (Ecumenical Council The opinions expressed by the various Protestant communities are almost universally favourable to the proposal.

Taking the report as a whole, it may be said that its chief value lies in its very clear presentation both of existing defects and of the main trend of critical thought which aims at reform. The pros and cons

of the schemes submitted are fairly set forth, so that anyone interested is able to acquire a knowledge of the points at issue very quickly. But it seems important to emphasise the view of the Committee that public opinion in general is as yet nowhere sufficiently informed to press for definite action in any particular direction of general reform (that is. apart from the Easter question). For example, the replies received from the various governments. show that only certain scientific bodies have as vet. been consulted, and it is suggested that now the preliminary eliminations have been made, the principles underlying the main groups of proposals. should be carefully studied and explained, and that to this end the investigation should be organised in each country on official or semi-official lines. It is the view of the Committee that until this is done an international conference to effect general reform could have no chance of success.

# The Second Greenland Expedition of the University of Michigan.

By Prof. WILLIAM HERBERT HOBBS, Director.

THE first Greenland Expedition of the University of Michigan was carried out in the summer season of 1926 within the Holstensborg district of south-west Greenland and was preliminary only in its nature. It was to pave the way for the second expedition, that of 1927-28, the primary object of which was to be to set up upon a mountain, as near as might be practicable to the inland-ice of Greenland, a meteorological and aerological station, and to continue observations there for the period of at least a year. Some account of the first expedition appeared in the January number of 1927 of the Geographical Review. The second expedition left Copenhagen on June 4, 1927, by Danish Government steamer a week behind the scheduled sailing of this vessel The expedition reached Holstensborg, south-west Greenland, on June 20, and two days later left for the Söndre Stromfjord (Kangerdlugssuak) on the Hvalrossen, a 22-ton motor schooner hired from the Danish Government at Holstensborg

On the way down the coast, one of the worst summer storms for this coast in many years was encountered, and the little craft was driven for shelter to a small inlet, the Inugsugtussok, where the expedition was storm-bound for seven days. On June 27, during a temporary lull of the storm, the little craft ventured out, but after being buffeted for several hours was compelled to put back after two boats had gone adrift, but, fortunately, had been recovered.

On July 2 the expedition reached its objective at the head of the great Sondre Strömfjord, one of the longest and largest fjords in the world, and in its lower reaches probably unsurpassed for grandeur of scenery. The expedition was fortunate in finding at the head of the fjord not only a suitable landing-place and base site supplied with running water, a rare thing in Greenland, but also in the immediate neighbourhood was found a mountain 1290 feet in height, easy of ascent and dominating the entire

horizon. Only fifty feet below the summit is a lake of excellent water, and the gradients were such as to make the transport of material to the summit not too difficult. This mountain has been named Mount Evans, and upon it has been located the aerological station of the expedition.

After the first organisation of the camp and protecting the stores from the weather, the heavy task of moving the building material to Mount Evans was at once begun. Lumber, supplies and equipment, the heavy radio batteries and generator, provisions for the year, and fuel for the winter, had all to be carried up from the fjord mainly on the backs of four of the seven members of the expedition and the four Greenlanders who had been brought in from the coast

By July 20 the central room of the hut, 9 ft. by 14 ft. on the ground, had been built and equipped, and one of the store-rooms as well. On this date Mr. Clarence R. Kallquist, the aerologist, and Mr. P. C. Oscanyan, jr, the radio operator, took up their residence in the hut, already equipped with self-recording instruments—barograph, thermohygrograph, single-register anemometer, etc—and with the aerological equipment. Beginning on July 21, a daily pilot balloon has been sent up, and all the instruments regularly observed.

As later completed in early September, the station hut is represented in Fig. 1. It was designed and constructed very largely under the direction of Fred Herz, a member of the expedition who has for years been associated with Prof. J. E. Church, another member of the expedition, and long the director of the Mount Rose Snow Surveys of California. The design has grown out of the experience at the Mount Rose mountain station, though it has been modified to meet the extreme conditions in Greenland. Its form is that of a low flat dome banked with sod and rock in such fashion as to give the wind but slight hold upon it. The inner living room is insulated by store-rooms along

the sides which have outer walls of sod and rock, and sod walls largely cover the ends of the building as well. The side walls of the inner room are of extremely thick canvas heavily waterproofed, and the room is lined with balsam wool one inch in thickness and in part covered with canvas. The

room has a floor with balsam wool beneath it. The end walls and roof are constructed in much the same manner except that here additional board walls afford rigidity and additional insulation. The two windows at the ends are of plate glass and double, with air space between. Ample ventilation is supplied at both ends of the room and at the ends of the store-rooms.

The site for the station was chosen at the head of this great fjord in south-western Greenland because a long arm from the inland-ice pushes out nearly to the sea on the south side of the fjord, and it was thought that this arm (unique in Greenland) would condense the moisture arriving in the 'lows' making their way up Baffin Bay.

making their way up Baffin Bay. This judgment seems to have been confirmed by the experience of the past season, for during the months of July and August, rains were of almost daily occurrence at the Danish settlements on the west coast, though we enjoyed clear skies at

seldom calm enough for the purpose, and the temperature relationships aloft are at such times much less interesting than when the wind is blowing. Efforts will therefore be made to use kites carrying the light Fergusson meteorograph, of which the station is provided with three. The pilot

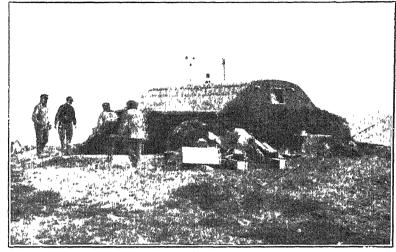


Fig 1 -Meteorological station near the margin of the inland-ice of Greenland.

balloon work will be continued once daily so far as practicable throughout the winter, making use of small lanterns during the dark period

The balloon studies thus far carried out already indicate that even in summer the Mount Evans station is almost entirely controlled by the inland-

ice circulatory system, the northern glacial anti-cyclone. With few exceptions the surface wind has been constantly from the easterly quadrants, and these extend upward to a height of about 1000 metres, where they are replaced by currents from the west which pass in over the ice. On Aug. 4 a very remarkable condition, and thus far unique in our experience, was discovered by the pilot balloon ascent A 73-minute run to 13,000 metres and 37,000 metres distance showed that the east wind, although weak at the surface, continued to the highest point reached. This was so remarkable that a second balloon was at once sent up and followed for 55 minutes, with the result that it checked almost exactly

with the first It will be interesting to learn what conditions were observed elsewhere on that day.

The delays at the beginning before reaching our base and the heavy labour of erecting the station on Mount Evans, left the expedition handicapped in its effort to advance over the inland-ice. Two reconnaissances had early been carried out and the inland-ice reached near the head of the great valley



FIG 2 —Mr Kallquist, the aerologist, following a balloon with the theodolite at the meteorological station on Mount Evans; Mr. Oscanyan is behind the instrument.

Mount Evans. The clearness of the atmosphere within this hinterland of south-west Greenland is best attested by the fact that the average run of our pilot balloons has been fifty minutes, and the average distance to which they have been followed has been thirty kilometres.

On Sept. 9, a free-rising captive balloon was sent up to a height of 1200 metres, but the days were

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which extends the present fjord to the ice maigin In this district the inland-ice pushes out two tongues, which have been named the Russell and Leverett glaciers

It was not until Aug 8 that it was found possible to set out upon the expedition to the inland-ice, and arrangements had already been made with the Governor of Holstensborg for the Hvalrossen to come to our base at Camp Lloyd about Sept. 1 so as to bring three members of the expedition back to the coast in time to depart by steamer for Copenhagen. On setting out it was already clear that not more than a few days could be devoted to the ice itself. On Aug. 19 this little party, consisting of Belknap, Church, Herz, and the director, had reached the margin of the ice and set out upon its surface with stores and equipment loaded upon an Alaskan sled with harnesses for the four members of the party. At this time of the year the ice is without any snow cover whatever, and after leaving

pleted on Sept 3 and provisioned and fuelled for the winter A balloon inflating shelter large enough for captive balloons has also been constructed, and this greatly facilitates the aerological work such a location every structure must be made low, be built around with sods and boulders, and be heavily anchored if it is to withstand the winter A summer storm of hurricane force storms. occurred on July 21, the day after the central room and one store-room had been completed, and on this day the single-register anemometer recorded a wind velocity of 81 miles per hour This storm, which started in the south-east over the inland-ice and hauled into the south-west, preceded by about forty-eight hours, as we learned by our radio, the great storms along the whole Atlantic seaboard.

The powerful short-wave radio station on Mount Evans has taught us much concerning conditions of transmission within the district. Except during strong aurora displays, reception has been generally

good, and the New York Times news broadcasts have been received with great regularity. On the other hand, up to late September, transmission on shortwave by our 250 watt tube transmitter has been only rarely possible to distances beyond one thousand miles. Beginning late in September, contacts were established with the New York Times so that news despatches could be sent out. The station is equipped with a long-wave receiver, and its signals were heard distinctly at times when shortwave signals were blanketed out.

The ice-cap has been found to act apparently like an ocean, and the long waves come across it much better than they come to the station from other quarters. The weather announcements from

long-wave stations at Angmagssalik, on the east coast of Greenland, and from Reykjavik, Iceland, have been picked up regularly. It is hoped that amateurs and others will endeavour to communicate with our station during the winter. Its call is the Denmark-Greenland call with 1XL.

Because of the dog epidemic in north Greenland, it will be necessary for Bangsted to make up a team of dogs for the winter expedition from dogs available in the Holstensborg district. The difficulties of this expedition are fully realised, but Mr. Bangsted in mid-winter of 1926–1927 spent six weeks upon the surface of the inland ice to the eastward of Umanak, pushing his way a distance of eighty miles from the margin, turning back to a point twenty miles within the margin, and there carrying out meteorological observations for eighteen days before returning to Umanak. He will spend such time upon the ice and push his way to such a distance as conditions in the winter will make possible, starting out from the Mount Evans station and returning to it from the ice.

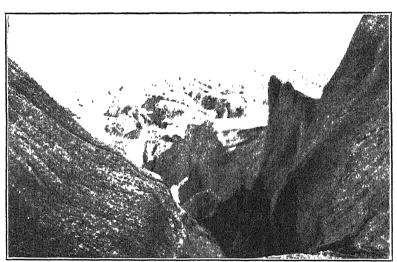


Fig. 3 —The rough surface of the inland-ice of Greenland over which the expedition had to advance

the immediate margin its surface was found to be so rough that the sled had to be relieved of most of its load and this carried forward in relays upon the shoulders. Without the crampons or climbingirons one could scarcely advance at all, and in the six days spent upon the ice an advance of less than eight miles was made. Pilot balloons were sent up on Aug. 23, and the party returned to its base after a 21 days' absence. Before turning back, an altitude upon the ice-surface of 2200 feet had been reached. On the return, depots of provisions and equipment were left behind for the use of a winter ice-cap party which will make the attempt to invade this region after the winter blizzards have filled the channels and packed the snow, and when the tundra surface separating Camp Lloyd from the ice margin is deep in snow and suitable for the use of dog-sleds. The winter party will consist of Mr. Helge Bangsted and Prof. J. E. Church, who have been making their preparations at Holstensborg.

The station on Mount Evans was finally com-

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# Progress of Aeronautical Research in Great Britain.<sup>1</sup>

By H. E. Wimperis, Director of Scientific Research, Air Ministry.

N all countries alike the two most disquieting aspects of aviation to-day are the frequency of accidents to service aircraft and the necessity for subsidising nearly all civil aviation enterprises; it is therefore natural that research should concentrate upon the problem of increasing the safety of aircraft in addition to striving towards improving what is known as 'performance.'

There are obvious reasons why any craft moving in a three-dimensional medium should be safer than the older two-dimensional form of transport; that this is not yet the case is largely because all conventional types of aeroplane depend for their sustenance upon a horizontal speed of some 50-60 miles an hour, relative to the surrounding air. If this necessary speed be lost, the loss of control which almost invariably follows is highly dangerous unless the height be sufficient for the aircraft to recover speed If we can ensure that it will merely fall at a fairly steep gliding angle instead of starting to spin, then there is every prospect of 3 very considerable reduction in the number and . rious nature of aircraft accidents.

In England the problem has been attacked with vigour and a form of control has been evolved which, even at very large angles of incidence, has neither of the long-recognised defects of the conventional ailerons in stalled flight, namely, rapid weakening of power to bank the aeroplane, and the introduction of a yawing moment, which, if not countered by adequate rudder control, causes the aircraft to enter into a spin. This result has been achieved by the use of a slot in front of the aileron. The slot opening, which for convenience of design may or may not be quite zero in normal flight, increases as the aileron is depressed. Full scale tests have been carried out on a number of types of wing section and aircraft, and there would seem no doubt that the principle of the method can be made generally applicable. In the last few months a further simplification of the use of such a slot has been made by Mr. Handley Page: this is now under test and shows great promise. At the same time, the influence of the rudder-power on the control in stalled flight has been investigated. Although there is no evidence that safety in stalled flight can be achieved merely by increasing the rudder-power, research has indicated that the size of this control has a large influence on the rapidity with which a spin following a stall can be stopped.

It is common knowledge that some types of aircraft, when stalled, go normally into a spin and are not easily brought out, whilst other types of aircraft are difficult to spin. On what features of design does this difference depend? Can we, by a manipulation of the form and arrangement of wings, by disposal of the centre of gravity with respect to the centre of pressure or by some ar-

 $^{\rm 1}$  From a paper presented to the International Air Congress at Rome, October 1927

rangement of the control surfaces, ensure that a civil aircraft will never spin, and that a service aircraft will only have such degree of ability to spin as may be necessary for its particular duty? We know, for example, that a forward position of the centre of gravity will lessen in some degree the danger of an involuntary spin; we know that when positive stagger is reduced, the spinning properties of a biplane are more dangerous, but the picture is far from complete; though it may be said that the mechanism of a spin in undisturbed air is now generally understood.

A somewhat extreme example of an aircraft designed primarily to affect control at and beyond the stall, is the Pterodactyl, a tailless aeroplane, designed and constructed by Capt. G. T. R. Hill, with the financial assistance of the Air Ministry. This aircraft provides adequate control at low speeds by virtue of the fact that the fairly large floating control surfaces at the wing tips are fully effective at all probable angles of incidence of the mam planes. Successful full scale trials have been carried out with a lightly loaded tailless aeroplane, and it has been demonstrated that the aircraft has no tendency to autorotate. A tailless aircraft with higher wing loading is being built to the

order of the Air Ministry

It will be seen that much is being done to counteract the disadvantages arising from the natural limitation of the conventional fixed wing aircraft, namely, the dependence for sustenance upon a considerable forward speed. An alternative is the helicopter. We in Great Britain have from time to time looked not unhopefully along that road, but we have been compelled to turn away, always, indeed, with a little greater knowledge, but with a still greater respect for the magnitude of that attractive if elusive problem. But the task now seems not so hopeless as it once did. We have in England to-day a rotating wing aircraft having very attractive stability and controllability characteristics; I refer to the autogiro, the invention of Senor de la Cierva, belonging to the class we now call the 'Gyroplane.' This aircraft, by virtue of the hinging of the blades so that they can rise and fall as they rotate, escapes the instability which seemed at one time to be inevitably associated with rotating wing aircraft. Although not a helicopter, since it is not able to rise vertically from the ground, it is capable of almost vertical descent in a moderate wind It cannot yet be said that it will compete with the more conventional types of aircraft at high speeds, but for some purposes it would be advantageous to sacrifice high speeds in order to achieve safe landing in confined spaces. Research is proceeding, a number of gyroplanes are being built, and the nature of the forces involved in the flapping motion of a rotating wing are being investigated theoretically and by experiments in a wind tunnel. Moreover, the possession of a full scale rotating wing aircraft, the characteristics of which can be studied in actual flight, represents an exceedingly important advance towards the solution of the helicopter problem.

Of the other researches which are proceeding with the object of increasing the safety of aircraft, perhaps the work on wing flutter is of most general interest. It is well known that certain types of aircraft exhibit a dangerous wing flutter when diving at high speeds. We, in England, have not escaped this trouble, but happily we are within reach of an appreciation of the features of design Theoretical investigations which which cause it have been carried out at the National Physical Laboratory, and recent wind tunnel experiments at that establishment, have shown that it is possible to reproduce on a specially constructed model the various types of flutter indicated by theory. Research is proceeding, but already it is clear that the mass distribution and aerodynamic loading of the ailerons is a factor of prime importance scale experiments have also supplied very valuable data on the nature of wing flutter, and tribute must be paid to the skill and courage of the many pilots who willingly face the risk of diving aircraft at such speeds that flutter ensues, the knowledge so gamed is of the utmost value, but it is better to substitute work on the model scale for such dangerous tests wherever possible

On the subject of increasing aircraft 'performance,' one's thoughts turn naturally to the engine. One of the most amazing of modern engineering achievements is the production of a reliable power unit weighing little more than 1½ lb. per horsepower at ground level. For special purposes, such as for the recent Schneider Trophy competition, engines have been constructed weighing considerably less than 1 lb. per horsepower, but of course these engines are not yet suitable for general purposes

Engmes with gear-driven and with exhaust-driven superchargers have been built and have shown satisfactory power outputs at altitude, but our knowledge of how far the advantage of increased power is outweighed by the increase of weight, head resistance, fuel consumption, and of fire risk with the exhaust-driven type, is still incomplete.

There is another direction, however, in which attempts are being made to meet the need for operating in an atmosphere of variable pressure. It is well known that engines running at ground level, on ordinary aviation spirit, exhibit a tendency to detonate if the compression ratio exceeds about 5:1. At altitude the decreased air density and temperature allow higher compression ratios to be used without detonation, and for this reason most engines are designed to have a compression ratio larger than 5:1, detonation at low altitude being avoided by throttling the engine. tions such as these have led to a search for a suitable fuel which will stand a higher compression ratio without detonation. Tests on variable compression engines have shown that by adding some 20 per cent. of benzol, the compression ratio can safely be increased to 5.8:1, with a resulting decrease of

the weight per horsepower and a decreased fuel consumption, but for many reasons this method is unsatisfactory

It seems not unlikely that the best solution will be the addition to petrol of small quantities of 'dope,' the best known being a mixture of tetraethyl-lead and ethylene dibromide Indeed, it is not too much to say that the discovery of a 'dope' entirely suitable in its supply, use, and storage, would mark a new era in engine design. The decreased weight-power ratio and fuel consumption consequent upon the use of high compression ratios would seem only to be limited by the skill with which the designer could deal with the higher explosion pressures without undue increase of weight. It is clear that there is no lack of incentive to work in this direction. In England intensive research has been carried out at the Air Ministry Laboratory, at the National Physical Laboratory, and at Oxford on the physical and chemical nature of the phenomenon of detonation and on the effect of using 'doped' fuels. Much progress has lately been made; according to Prof. Callendar, working at the first-named establishment, detonation is due to the formation of organic peroxides which become concentrated in the nuclear drops during compression and ignite the drops simultaneously when the detonation temperature of the peroxide is reached. Although much has been done, it still remains to discover a 'dope' which will be entirely satisfactory in an engine, be non-poisonous, and will not deteriorate in storage. For civil aviation purposes, such a 'dope' would be invaluable, since the need for power at ground level at present conflicts with the necessity for using engines having a low compression ratio.

Every decrease of the weight-power ratio of aero engines inevitably focusses attention on the problem of effecting economy in fuel consumption. The average aero engine consumes its own weight of fuel in four or five hours, and it may well be argued that efforts to reduce the fuel consumption have not kept pace with the reduction of the weight of the engine itself. For long-range civil aviation, this problem is of particular importance. If, by the use of 'dopes' it were possible to use as high a compression ratio as, for example, 10:1, a substantial reduction of fuel consumption would be achieved. There is, however, another avenue of progress—the heavy oil engine. If the prospect of using compression ignition engines on heavierthan-air machines is still distant, the advantages to be derived therefrom are so important that the ultimate displacement of the petrol engine by the heavy oil engine can scarcely be doubted.

With regard to the design of the aircraft itself, it would seem that any signal advance must await the discovery of a new alloy or some new treatment of an existing metal or a new aerodynamic principle. There is room, however, for progress along less spectacular lines. Fundamental aerodynamical investigations are proceeding, and the later R A F. wing sections have been successfully designed in

accordance with the Kutta-Joukowski aerofoll theory. Preliminary experiments have been made on the removal of the boundary layer from the upper surface of an aerofoll by suction from points well forward in the section, it has been found that the maximum lift is considerably increased thereby.

Similar results could no doubt be obtained by the emission of air under pressure; but it will be appreciated that this is in reality the principle of the Handley Page slot, which, moreover, has the advantage of being independent of any pumping plant.

#### News and Views.

THE Council of the Physical Society has awarded the Duddell medal for 1927 to Dr. F. E Smith, Director of Scientific Research at the Admiralty. This medal is given annually for work in connexion with the development of scientific instruments or of materials used in their manufacture. Dr. Smith's work at the National Physical Laboratory on the development of electrical standards is too well known to require emphasis. He was trained at the Royal College of Science, 1895-1900, under the late Sir Arthur Rucker, entering the National Physical Laboratory in 1900. There he formed one of the band of pioneers who, under Sir Richard Glazebrook, did so much to raise the scientific work of the Institution to its present high level. His earliest work was concerned with modifications of the Wheatstone and Kelvin bridges for precise measurements of resistance, and the development of bridges for accurate platinum resistance thermometry. A classical piece of work followed on the current balance, by means of which it was found possible to evaluate a current of the nominal value of 1 ampere to within 1 part in 50,000. In the course of this work he developed the silver voltameter which bears his name and is generally accepted as the most trustworthy form of voltameter, in that there is no envelope between the anode and cathode. The successful development of the modern mercury-in-glass resistance standards is largely due to Dr. Smith's work. His specification for the Weston normal cadmium cell is the one generally followed. It is now no uncommon experience for a batch of twenty standard cells to be made commercially in which the E.M.F. given by the cells agrees to 1 part in 10,000. Dr. Smith was also responsible for the design of the Lorenz apparatus (the Viriamu Jones Memorial) installed at the National Physical Laboratory. He has also developed various magnetometers for the measurement of the magnetic intensity of the earth's field; one of his instruments now forms the standard for the measurement of the horizontal intensity at the Magnetic Observatory at Abinger. In 1920, Dr. Smith left the National Physical Laboratory to take up his present post at the Admiralty. He was president of the Physical Society for 1923-24. As one of the honorary secretaries of the British Association, his organising ability is being devoted in a striking manner to the advancement of science.

Mr. ROBERT MOND has been appointed a member of the research council of Imperial Chemical Industries, Ltd., to which reference was made in our issue of Dec. 10, p. 850. Mr. Mond has carried out notable research in pure and applied chemistry and has given particular attention to electrolytic problems. He was associated with his father, Dr. Ludwig Mond, in researches on the metallic carbonyls and the action of nitric oxide upon them. In other directions Mr. Mond has also contributed in a substantial way to scientific progress by his original work and personal influence, and he is as highly esteemed for his Egyptological explorations and studies as he is for his contributions to physical and chemical science. He is honorary secretary of the Davy-Faraday Laboratory of the Royal Institution and honorary treasurer of the Faraday Society; and many other societies and scientific organisations are indebted to him for generous support and encouragement.

Ir has long been known that the difference between good and poor pastures is not dependent alone upon the energy value of the herbage or the proximate food constituents—carbohydrate, protein and fat. The consequent investigations of mineral deficiencies, notably at the Rowett Research Institute, have already proved to be a well-directed inquiry. The discussions at the recent Imperial Agricultural Research Conference have made it abundantly clear that malnutration consequent upon mineral deficiencies in pastures is widespread through the Empire. From South Africa one hears that 'styfsiekte' in cattle arises on certain veld soils, the vegetation of which contains ss than the optimum requirements of phosphorus. The ruminant stock of the North Island of New Zealand have for some time been troubled with 'bush sickness,' a condition of anæmia and general emaciation which has now been shown by Aston to be correlated with iron deficiency. In the Bihar district of India low milk yield is consequential upon a low phosphorus content of soil and crops. The high mortality among sheep in the Falkland Islands has been found by Godden to be collateral with low lime and phosphorus percentages in the pastures. Similar evidence of malnutrition among Australian sheep is forthcoming. The pastoral industry of Australia contributes about 25 per cent. of the national income, a fact which makes the immediate investigation of mineral deficiency diseases imperative. These deficiency diseases are becoming more evident with the increasing population of the colonies, and the subdivision of the larger holdings. Stock migrated from one area to another in earlier days and so unconsciously secured adequate mineral supplies. The continuous maintenance of stock on the same area has now given rise to this new problem in nutrition, which is to receive full and immediate investigation largely through the cooperative efforts of the Empire Marketing Board, the Australian Council for Scientific and Industrial Research, the University of Adelaide, and the Rowett Research Institute.

At the thirty-second winter general meeting of the Institution of Water Engineers, held in the rooms of the Geological Society on Dec. 9, the following resolution was proposed by Capt. W. N. McClean, seconded by Mr. S. R. Raffety, and unanimously carried. "That there is urgent need of an organisation which will ensure a continuous record of the flow and storage of surface and underground water, and this Meeting desires the Council of the Institution to consider and report in what directions such investigation might be profitably developed." It is satisfactory to learn that water engineers are themselves dissatisfied with the present position in regard to the records of the flow and storage of surface and underground water. The subject is one of national importance; and for the adequate and equitable utilisation and development of the available water supplies, it is essential that statistical information should be generally available in regard to the distribution and amount of the supplies.

THE proposal in the Electricity Bill (1926) that all the electricity supply companies in Britain should supply alternating current energy at a standard frequency of 50 was the proposal which was most criticised. It was pointed out that in order to standardise the frequency it would be necessary to change over some of the largest supply systems in the country. The National Electricity Board, instructed by the Electricity Commissioners, is now supervising this change. The Electricity Department of the Glasgow Corporation is one of the first to change over. Glasgow, which generates at a frequency of 25 cycles per second, is included in the area covered by the central Scotland scheme. The problem presented by the change over was quickly solved by instructing the English Electric Company to build for the Dalmarnock Power Station a 50 cycle turbogenerator set which has an output of 25,000 kilowatts. This unit takes the place of one of the existing 25 cycle machines. All the other units in the station will gradually either be converted or replaced. Active steps are thus being taken to secure for Great Britain the great boon of an electric supply of standard frequency.

In connexion with the Associated Edison Illuminating Companies' Convention at Colorado Springs, a spectacular method of illumination was shown. The sunken garden of the Broadmoor Hotel was flooded with invisible ultra-violet rays from quartz tube mercury vapour lamps fitted with powerful reflectors. The light was filtered through special lenses made of Corning glass which obstructs all the visible light. It also prevents the band of short wave energy deleterious to the eyesight from passing through. As silvered glass reflectors absorb ultra-violet rays it was found necessary to make the reflectors of polished aluminium. The flowers, shrubbery, and evergreens were sprayed with chemicals which fluoresced under the ultra-violet rays. The chemicals used were zinc sulphide, eosin and

rhodamine. Each individual leaf, twig, or flower glowed in various colours. The water in the fountain in the centre of the garden was also treated with fluorescent chemicals so that it became brilliantly luminous when the rays fell on it.

LEPLAY HOUSE, 65 Belgrave Road, London, S.W.1, deserves wide publicity. Founded in 1920 on sociological principles laid down by Frédéric Le Play, principles that have been interpreted and enlarged by Patrick Geddes in studies associated with the Outlook Tower at Edinburgh, the House has worked steadily toward the better understanding of the complexity of city and regional life. Its work may well be styled the sociology of locality, the study of intricate and multifarious parts and functions as members one of another. From the beginning the main purpose has been to promote and assist discussion, study, and research in the field of sociology, and to apply the results to practical civic developments. This has been done by surveys undertaken through its own members or by voluntary and public organisations acting under its inspiration and advice. No one doubts to-day the wisdom of such surveys. The days of haphazard growth are past. Some scheme or plan of future development based on accurate knowledge of conditions is essential if a better future is to grow harmoniously out of an indifferent present. Local surveys cannot, however, be isolated from each other. Distance is the function, not of space, but time, and new means of transport, of thought no less than goods, are changing rapidly the geographic values of places. Regional surveys need themselves to be surveyed from a national viewpoint. This in practical politics means a central bureau capable and willing to advise and to co-ordinate. Leplay House fulfils these conditions, and the appeal by the Committee for Civic and Regional Institutes made on its behalf for personal and financial support should meet with ready response.

Previous to the founding of the Zeitschrift für Krystallographie und Mineralogie in 1877 by Prof. P von Groth, whose recent death at the age of eighty-five years we regret to announce, crystallographic papers in Germany had been published mainly in the Annalen der Physik und Chemie (Poggendorff), and mineralogical papers in the Neues Jahrbuch fur Mineralogie, Geologie, etc. The want of a journal devoted to crystallography was then beginning to be felt, but in order to gain a circulation it was at first necessary to add also mineralogy. When, in 1921, the editorship was taken over by Prof. P. Niggli, crystallography had made such rapid advances, due to the new X-ray methods of investigation, that a journal devoted to it entirely could be self-supporting, and the title was accordingly changed to Zeitschrift fur Kristallographie, as originally planned by Groth. In the current issue—the first part of vol. 66-Prof. Groth gives an interesting historical review and recounts the support he received from workers in many countries during his forty-four years of editorship.

As further marking the jubilee of the Zeitschrift für Kristallographie, some other changes are now intro-

duced with the view of making the journal still more international in character. On the wrapper the names of eighteen well-known workers (in twelve countries) are given as associate editors, the representatives in England being Sir William Bragg, Prof. W. L. Bragg, and Sir Henry Miers Of the fourteen papers contained in this issue, nine deal with the structure of crystals as determined by X-ray methods, and two of these are printed in English. There are also two separately-paged appendices giving connected reviews, rather than a disjointed series of abstracts, of special branches of the subject. Although the Zeitschrift is printed and published in Germany, the editor in chief, Prof Niggli, is Swiss, and an inspiring teacher in Zurich. Such international cooperation in science is a healthy sign and promises well for the future As further evidence of international goodwill in mineralogy, mention may here be made that, at the annual meeting of the German Mineralogical Society in Breslau last September, Sir Henry Miers and Dr. L. J. Spencer were elected honorary members, and that at the last meeting of the Mineralogical Society of America, Dr. Spencer was elected an honorary life fellow.

EXCAVATIONS at Ur were closed down prematurely last year on account of lack of funds at a moment when exceptionally important finds of jewels and other antiquities gave every promise that the expedition was on the eve of discoveries of the greatest interest. This promise has been amply fulfilled by the opening of the current season Excavations resumed at the same point have already brought to light a royal tomb of two chambers built of large unhewn blocks of limestone, with walls three feet thick. This is in itself remarkable in an area in which this material was entirely absent, and was, therefore, extremely costly. The tomb had unfortunately been rifled, and the royal chamber produced little; but the outer chember, in which the king's attendants had been buried, contained one body which had not been disturbed. With this were personal ornaments of gold and silver. A number of copper vessels had been crushed by the roof, but a silver vessel with fluted sides was recovered. Notwithstanding the disappointment of finding the tomb rifled, the discovery is of importance for the light it throws on royal burials in early Mesopotamia. An adjacent grave, however, in which the coffin was intact, has provided a rich treasure. Mr. C. L. Woolley, who describes the find in the Times of Dec. 16, considers that it must have been the grave of a member of the royal family, though not of a king. The name Mes-kalam-dug is inscribed on each of the gold vessels taken from the coffin. A great variety of articles in silver, copper, and goldpersonal ornaments, axe-heads, lance-points, saws, chisels, etc., as well as gold and silver vessels, was found. One of the most remarkable objects was a gold peruke which completely covered the head of the skeleton from the forehead to the nape of the neck. It is interesting to note that four lances with gold-mounted shafts had been placed, one at each corner of the grave.

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In Germany, high pressure voltages exceeding 100 kilovolts have been used for the transmission of electric power over long distances for nearly twenty years. The cities of Berlin, Magdeburg, Leipzig, and Dresden are provided with electrical energy by means of an extensive 100 kilovolt network, which is supplied by the super-power stations situated in the lignite districts in Central Germany. Overhead lines also transmit at this pressure power obtained from waterfalls throughout the States of Baden and Württem-Dr. Cohn, in the October number of AEG Progress, published by the Allgemeine Elektricitats Gesellschaft of Berlin, describes and gives a map of the super tension networks erected and projected in Germany. The development of these networks, although retarded, was not interrupted by the War, and has been taking place very rapidly ever since. It is stated that if we have to consider economy, electric power can only be transmitted about 130 miles at 100 kilovolts. To transmit power economically from southern to central Germany, a distance of about 360 miles, would require a pressure of at least 220 kilovolts. Lattice girder poles are exclusively used for high pressure transmission in Germany. For 220 kilovolt lines the distance between the poles varies from 300 to 400 metres, but when the lines have to cross rivers and valleys much greater lengths of span are used. The Water Power Conference at Basel in 1926 recommended the linking up of the power systems in various countries, as this is to their mutual advantage. In the near future important developments in this direction are expected.

In 1924, Finland invited representatives of the States bordering on the Baltic Sea to a conference from which resulted the setting up of a Baltic Geodetic Commission to deal with geodetic matters in which co-operation between these States is of importance. The second conference was held in Stockholm in 1926, the countries which took part being Germany, Finland, Sweden, Denmark, Danzig, Esthonia, Lettland, Lithuania, and Poland. The annual contributions of member-States are 500 dollars for the first three and 250 for the remainder. The conferences are held annually, and the report of the 1926 meeting has just been issued. The matters dealt with included remeasurement of the base lines in the various countries by the same observers with the same instruments; the measurement of triangles overlapping two States by observers of each State, independently of each other; the longitude differences between the standard stations in the various States; and measurements of gravity. The Commission considered the enlargement of its scope to include magnetic surveying over the Baltic Sea and adjoining lands, but a decision on the matter was postponed until the 1927 conference.

An illustrated article by E. H. Wilcox contained in the Scientific American for December describes how in the United States large areas are protected from lightning strokes by a ring of high steel towers, the tops of which are connected by wires. The wires are provided with numerous steel points, which dissipate the ground charge induced by a lightning cloud. By continual point discharges the potential gradient between the cloud and the ground is kept below the value necessary for the occurrence of a lightning flash; the principle of the method is thus opposite to that of the ordinary lightning conductor, which is designed to offer an easy and safe path to the lightning discharge. The wires carrying the discharging points are all well grounded and connected electrically with the reservoir or other object which is to be protected. The method has been applied to great open reservoirs of petrol in California, where temporary over-production has necessitated this method of storage.

PROF HENRY J. SPOONER has an article in the Society of Industrial Engineers Bulletin (vol. 9, No. 9), on the progress of the movement for the reduction of noise. He discusses noise in the home, in the streets. rubber roadways, noise in the work-place, and the cost in human wastage and in depreciation of property. He complains that research bodies have so far done nothing or next to nothing with regard to the problem. With much of what the writer says everyone will be in agreement. The reduction of noise would be of very great value to the community, and there is little doubt that the noise made by some machines could and ought to be diminished. The scientific study. though of the effects of noise on individuals, whether that noise be in the form of street noises or of particular noise from machines, is not easy. Efforts are being made now by the Industrial Fatigue Research Board to collect data with regard to the effect of noisemaking machines in clerical work. So far there has been no evidence of more sick leave or of a higher labour turn-over in departments using noise-making machines than in other departments. The individual reactions to the noise are complicated. One question that arises is how Prof. Spooner has arrived at his calculation of £50,000,000 economic loss through the There are so many variables in effects of noise. calculating the effects of any economic factor that one would like to know whether the figure belongs to the domain of scientific fact or popular fiction.

APPARENTLY there are only a few more parts of that monumental work, "A Critical Revision of the Genus Eucalyptus," by J. H. Maiden, yet to be published, 68 parts having already been issued, so that students of the Australian flora are awaiting the completion of the book, and particularly the key to the species, with eager anticipation. The almost inevitable postponement of publication of the key until the whole work is finished, is one of the chief defects of a monograph of this type in which publication is continued over a period of years, the first part of the present work having been issued in 1903. The difficulties arising from this are enhanced by the fact that no comprehensive scheme of classification of the genus has appeared in Mr. Maiden's "Revision." No doubt this will be remedied in the last parts, but certainly the usefulness of the book up to the present has been greatly impaired by these omissions, unavoidable though they may be. It has been announced that the manuscript for the last parts was completed by Mr. Maiden before his death, so that these may be expected to round off the whole work. In addition

to much valuable information of the usual type found in monographs, there is a great deal of subsidiary matter (e.g. classification of barks, timbers, fossil records, enemies, ecological notes), often illustrated by copious figures. The economic aspect of the genus has been dealt with fully, while numerous references to other work on the timber, oils, gums, etc., are included. However, unless some arrangements have been made for the issue of special sets bound up differently from the normal, it seems that the morphological and additional information will remain scattered here and there throughout the latter parts of the book. Criticisms in detail are best left until the work is complete: it may be pointed out, however, that the late Mr Maiden collected an enormous amount of information together, and even as it stands the book is invaluable to anyone working on the flora of Australia

A SECOND International Conference on Bituminous Coal will be held at the Carnegie Institute of Technology in Pittsburgh, Pennsylvania, U.S.A., during the week commencing on Nov. 19, 1928. The first conference was held at the Carnegie Institute in November 1926, and was devoted to discussions of the better utilisation of bituminous coal. It was attended by 1700 persons, including delegates from thirteen different countries. No definite programme for the second conference has been made, but it is expected that the latest developments in obtaining substitutes for petrol from coal, power from coal, low and high temperature distillation processes, smokeless fuel, gasification of coal, utilisation of coal tar products, coal as a source for fertiliser, and coal in relation to the production of fixed nitrogen, will be discussed.

The British Journal of Actinotherapy for October (vol. 2, No. 7) contains an article by Prof. Birch-Hirschfeld, of Konigsberg, on the value of ultra-violet rays in ophthalmology, particularly in the treatment of ulcers of the cornea and conjunctiva. This journal, which is devoted to the medical and scientific aspects of ultra-violet rays, is now published at 17 Featherstone Buildings, W.C.1.

The Ministry of Health has issued new Regulations (Statutory Rules and Orders, 1927, No. 1004), to date from Jan. 1, 1928, revoking the Public Health (Pneumonia, Malaria, Dysentery, etc.) Regulations, 1919. Trench fever drops out, as it is apparently now an extinct disease. Although malaria remains notifiable, the new Regulations exempt from notification a case of malaria in which the disease has been induced in an institution for therapeutic purposes (e.g. the treatment of general paralysis). But such a case, if liable to relapses, must be notified at least four days before discharge to the medical officer of health of the district in which the patient proposes to reside.

The exhibition by Mr. Burchell and Mr. J. Reid Moir at the rooms of the Society of Antiquaries of finds of archæological interest from Sligo has led two correspondents to express their views in letters to the Editor. Mr. Henry Dewey, of the Geological

Survey and Museum, Jermyn Street, London, S W.1, states that he has seen the specimens and documentary evidence, and is of opinion that "certain features shown on the 'implements' could be formed only by human agency . . . a parallel as regards their form and technique can be found among the Levallois implements discovered at Northfleet, Kent" Mr. R. Vernon Favell, Penberth, St. Buryan, Cornwall, states that he was greatly impressed by the exhibit, and that "the implements and cores are undoubtedly of human workmanship in the Mousterian manner."

Mr. W. E. MILLER, writing from Avenue Rambert, Clarus, Switzerland, describes observations on four occasions recently of a third rainbow bow inside the primary bow, and asks for an explanation of the phenomenon The rambow appears to have been a supernumerary (German, sekundare) bow The optics of these bows is described in the third volume of the "Dictionary of Applied Physics," page 525, in Dr. Humphreys' "Physics of the Air," page 463; and in Pernter and Exner's "Meteorological Optics," 2nd edition, page 531 onwards. On page 594, Pernter and Exner give some notes as to the deductions about the size of the raindrops which can be drawn from the observation of these supernumerary rainbows may be of interest to recall that in Nature of Nov. 9, 1911, there is an account of an observation by Mr E Newbery of a number of brilliant rainbows

one time six rainbows were simultaneously visible, of which four seem to have been supernumerary bows. The colours of supernumerary bows appear usually to be green and violet, but that is not invariably the case. One of the supernumerary bows observed by Mr. Newbery was nearly white.

MESSRS Dulau and Co, Ltd., 32 Old Bond Street, W 1, have just circulated Catalogue No. 155 of some 400 new and second-hand books on entomology. It will be sent free upon application.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned · - A demonstrator in physical chemistry in the University of Leeds—The Registrar, The University, Leeds (Jan. 10). A head of the chemistry and industrial chemistry department of the Technical College, Cardiff - The Principal, Technical College, Cardiff (Jan. 21). Lecturers in the Massey Agricultural College, New Zealand, as follow. Inorganic chemistry and soilchemistry, botany and field husbandry, agricultural economics and book-keeping, veterinary science and animal husbandry, agricultural bacteriology, agricultural zoology-The High Commissioner for New Zealand, 415 Strand, W.C 2. A junior assistant chemist under the directorate of explosive research of the Research Department, Woolwich-The Chief Superintendent, Research Department, Woolwich, S.E 18.

#### Our Astronomical Column.

SKJELLERUP'S COMET.—A new orbit of this comet, differing considerably from that of Mr. H. E. Wood, has been computed by Mr. B. H. Dawson, of La Plata, and distributed by the I.A.U. Bureau. Copenhagen.

$$\begin{array}{cccc} \mathbf{T} & 1927 \; \mathrm{Dec.} \; 18 \cdot 200 \; \mathrm{U.T.} \\ & \omega & 20^{\circ} \; 58' \\ & \Omega & 78 \; 43 \\ & i & 82 \; 41 \end{array} \right\} \; 1927 \; 0 \\ \log q \; 9 \cdot 5092$$

EPHEMERIS FOR 0h.

The new orbit agrees better than Mr. Wood's with a telegram received by the Astronomer Royal from Mr. Chidambarier, assistant at Kodaikanal Observatory, stating that the comet was seen there (evidently in full daylight) about two diameters east of the sum on the morning of Dec. 15. It was then at its nearest to the earth, log  $\Delta$  being 9812.

The new orbit makes the comet brighter than the former one did, but much lower down, and better placed for observation before sunrise than after sunset, though it may perhaps be seen in both positions. The comet was observed at Hanover and Hamburg on Friday evening, Dec. 16, and had an appreciable tail.

JUPITER.—Mr. B. M. Peek and the Rev. T. E. R. Phillips discuss (B.A.A. Jour. for November) some recent observations of bright spots on Jupiter's north equatorial belt. The chief point of interest is that the rotation period of the spots was intermediate

between the equatorial rate  $(9^h 50^m)$  and the temperate rate  $(9^h 55^m)$ ; also the period appeared to increase during the series of observations, thus approximating more closely to the temperate rate. It is very rare to find spots showing these intermediate values. Mr. Phillips suggested that the increasing period might be due to their rising higher in the Jovian atmosphere so that their durinal circle became larger.

At the meeting of the Royal Astronomical Society on Dec. 9, Prof. Turner exhibited some beautiful photographs of Jupiter taken by Prof. Douglas in light of various wave-lengths. Some of these were arranged to give a stereoscopic effect, by combining exposures a few minutes apart.

THE LIGHT CURVE OF MIRA CETI -This wellknown variable has recently passed through maximum, so it is of interest to note the results of observations in the last few years. There is an article on it in L'Astronomie for November, giving the results of three observers, L. Jacchia at Udine, C Popovici at Galatz, and E. Loreta at Bolognia. Minimum, mag. 93, was passed on 1924, Sept. 26, and maximum, mag. 34, on 1925, Jan. 10, or 106 days later; there was a curious pause on the decline, in February 1925, when it remained for 16 days at mag. 4 (Observer, C. P.). The next maximum occurred on 1925, Dec. 5, according to E. L., but 6 days earlier according to L. J. Both gave the mag. as 3 1. The next was on 1926, Oct 24, according to E. L., 3 days earlier according to L. J. Both gave the magnitude as 3·1. The light-curves, as drawn, progress quite smoothly except in February 1925. The last two minima could not be observed, as the star was too near the sun. On the other hand, the maxima now occur with the star near opposition, so the conditions for observation are very good.

#### Research Items.

ANTHROPOMETRY IN CENTRAL AUSTRALIA —A first instalment of the results of the University of Adelaide Expedition to Central Australia at the beginning of 1927, which appears in Vol. I of the Transactions of the Royal Society of South Australia, gives a general introductory account of the expedition and its method of working, and deals more specifically with the results of the anthropometric observations by Dr. T D. Campbell and Mr. C S. Hackett. Two halts were made, one at Ross Waterhole, 40 miles northeast of Oodnadatta, and one at Stuart Town, Alice Springs. The natives observed were Arunta with a few Luritcha, numbering 57 in all, 44 male and 13 female, and with a few exceptions all were full blooded. In addition to the anthropometric measurements, a number of investigations were carried out, including a study of aboriginal songs, and the expedition was fortunate in obtaining a kinematograph film of a circumcision ceremony as well as other films of technological interest. A striking method of locomotion involved in an extreme case of platycnemia provided a film of exceptional interest The means of the anthropometric measurements given are: stature 1630 mm, head length 189.6 mm., head breadth 142 mm., nose height 52 l mm., and nose breadth 486 mm. Cephalic index 747, facial index 81·3, nasal index 93 mm It is to be noted that the head is slightly broader than that of other records. The larger size of the nose is probably due to the greater preponderance of males. Comparing these results with other records by various workers, it is now possible to give a generalised picture of the Australian as a dolichocephalic, platyrhine with pronounced supra-orbital ridges and protruding lips. in colour dark brown, with low to deep waves on the hair, which is occasionally curly but never frizzy.

SOME CHINESE FROGS AND TOADS.—Mr Karl Patterson Schmidt, in his "Notes on Chinese Amphibians" (Bull. Amer. Mus Nat. Hist., vol. 54, Art. 5, Oct. 1927), describes the Chinese amphibians in the American Museum of Natural History, most of which were collected by the third Asiatic Expedition. Amongst these are four new species and one subspecies—three Rana, one Bufo, and one Batrachuperus, which are described in detail. The distribution of the common toads of central China is interesting; a sub-species of Eufo bufo being common round about Shanghai and the east, Bufo bankorensis very abundant in the west, whilst in between both species occur. Notes on the food of Bufo bankorensis show that it eats beetles, ants, grasshoppers, millipedes, centipedes, earwigs, and spiders; also plant remains were found inside it, and even a small toad. Bufo raddei had fed entirely on beetles, and Kaloula borealis, as is apparently usual in the group to which it belongs, had eaten ants almost exclusively. Careful notes and descriptions are made of all the forms identified, and photographic illustrations given of six species.

Nematodes of Birds.—Eloise B. Cram (Bull. U.S. Nat. Mus., 140, pp. 465: 1927) has prepared an account of about 500 species of nematodes in approximately fifty genera of the sub-orders Strongylata, Ascandata, and Spirurata found in birds. Many of the descriptions are from obscure publications. and the author has done her best. often with inadequate data, to produce a critical account. Only seven new species are described. The main emphasis has been placed on the Spiruroidea, which may be regarded as primarily and

characteristically bird parasites. These have intermediate hosts which are eaten by birds, the water birds eat the entomostiacan intermediate host, and the insectivorous birds acquire the spirurid from The author directs attention to the observation of Seurat that infective third stage larvæ of spinureds in arthropods when eaten by hosts other than the final one, eg. by rodents, migrate into the tissues of such a host and again encyst as third stage larvæ Such an miected rodent would serve as a passive vector and would account for the infection of birds of prey. Keys are given to the orders, suborders, families, genera and species, which will greatly facilitate identification of these parasitic worms, and appended are a list of hosts with their respective odea and the Trichiurata are not dealt with in this memoir.

THE NATURE AND EVOLUTIONARY SIGNIFICANCE OF MUTATIONS —Considerable attention has been refocussed on the problems of evolution by this year's presidential address to the British Association, and the paper on mutations in the American Naturalist (vol. 61, Oct 1927) will be read with interest. Prof. Gates points out that while organic evolution is now generally accepted as a historical fact, there never has been greater difference of opinion concerning the causes of the vast diversification of forms of life we now know. The problem of specific diversity is certainly not a problem with a single solution, although many biologists still try to explain all specific differences and all phylogenies in terms of one evolutionary factor, or on one pet hypothesis. Prof Gates dismisses the Lamarckian factor as having so far no satisfactory experimental evidence, he is of opinion that the inclanic variations of Tephrosia bistortata obtained by feeding the larve on smoke contaminated foliage cannot be given a Lamarckian setting. These variations are in fact due to actual germinal changes induced in certain of the germ nuclei. In recent years our increased knowledge of the structure of gametes of organisms, and the way in which differences arise in the germ-plasm and are transmitted by inheritance, has thrown much light on problems connected with mutations. Mutants show visible gametic differences—differences in arrangement and structure of the chromosomes. These discrete changes in the germ-plasm are of many kinds, some 'spontaneous,' some connected with crossing, some induced by environmental factors. Of whatever kind, they must have played an important rôle in the production of species and varieties. In the tracing of phylogenies an increasing amount of importance is attached to parallel mutations and convergences, and the tendency of modern phylogenies is to deal less with divergences and more with parallelisms and convergences, a tendency shown in the recent conclusions of Bower on the phylogeny of the ferns.

CHIMERAS IN POTATOES.—Bud mutations in potatoes, involving changes in colour or shape of the tuber, are well known, but a 'kostroma' mutant from the Russian variety *Imperator* differs from the normal only in having more dissected leaves and corollas. As described by Miss T Asseyeva (*Jour. of Genetics*, vol. 19, No. 1), this mutant remains nearly constant when propagated from tubers, but occasional leaflets revert. Removal of the 'eyes' from a tuber leads to the regeneration of fresh buds which usually show reversion to the normal parent form. In this way

the 'kostroma' mutant was shown to be a chimera Similar experiments with several other potato varieties lead to the conclusion that many of them are pericipal chimeras in which the outer layer of the tuber differs in its genetical capacities from the inner ones. This may account for some of the phenomena of pollen sterility in potatoes, as well as for the fact that forms produced from seeds frequently have tubers different from the parent clone. It may also have an important bearing on the question of 'running out' in potato varieties. Several of the common varieties are indicated as chimeras, though they may also be hybrid in the ordinary sense. The author suggests that bud mutations are usually of a chimerical nature, but there is no indication as to how the potato chimeras may have arisen.

Forest and Prairie —At the last meeting of the National Academy of Sciences at Washington, Prof. Cowles, of the University of Chicago, discussed the probable fate of the great stretches of rolling grassland beginning in Illinois and stretching across Iowa and Minnesota into Kansas and Nebraska, if they had not been ploughed into corn and wheat lands A brief account of the paper has been issued by Science Service, of Washington Prof Cowles distinguished two types of prairies, edaphic and climatic. The former, occurring as interruptions in otherwise forested areas, are due to peculiar conditions of soil, soil water, soil chemistry or other soil conditions where they occur This type is by no means permanent, but exists as a stage in the development of some more stable type of vegetation trees that surround the edaphic prairie modify soil conditions along the border until they are able to creep over it and establish themselves on the grassland Climatic prairie is typified by the unbroken stretches of grassland in the west, and its existence is determined by general climatic conditions, regardless of local differences in soil It is a permanent type, to which all kinds of plant assemblies in the region gradually revert if left to themselves, for the climatic conditions under which it develops are unfavourable to tree growth. 'Tension line' prairies also, which occupy an intermediate position between edaphic and climatic prairie, will in the end become forest under a state of Nature

GEOGRAPHICAL FACTORS IN THE COTTON INDUSTRY. —The dependence of the cotton industry of Lancashire on imported raw material makes its location and growth at some distance from a seaport not a little remarkable, and especially was this the case in its early days, in the sixteenth and seventeenth centuries, when land transport was bad. In a paper in the Journal of the Textile Institute for November, Mr H. W. Ogden discusses the geographical basis of the industry. His paper is particularly valuable for the number of old and modern maps with which it is illustrated. He takes into account only the geographical factors, without denying that historical causes have also played their part. The cotton port was originally Chester, and it was not until the Dee lost its usefulness by silting that, early in the eighteenth century. Liverpool began to displace it. Mr. Ogden goes at length into the distribution of weaving and spinning in the cotton manufacturing area, and shows that the important geographical factors were the upland area to the east, with abundant rainfall, giving an even supply of soft water throughout the year. Soft water in abundance is required for all the processes of manufacture, while the application of steam power to the industry caused a further demand for it. Details are given of the distribution of rainfall.

OCEAN WEATHER.—A useful series of data is collected and tabulated from various sources by the Koninklijk Nederlandsch Meteorologisch Institut bearing on the weather of the Atlantic, Pacific, and Indian Oceans The pamphlet (Publication of the Institute, 107 B) giving the data for 1925 has now appeared. There is no map, but the ocean is divided into ten-degree squares from lat. 25° N. to 30° S. in the Atlantic, from lat. 10° N to 20° S. in the Indian, and from 30° N. to 30° S in the Pacific Ocean. For each month, in each square, is given the force and direction of the wind, pressure, temperature of the air, and water, cloud, and percentage of hours of ram. A few squares in the Pacific are blank, and the figures in some squares, especially in the Pacific and Indian Oceans, are based on few observations. Others in the northern Indian Ocean are the result of several hundred records. The publication is considerably interesting, especially after the data have been plotted on charts.

RIFT VALLEYS.—An important paper on fault troughs, both superficial and profound, appears in the Journal of Geology, p 577, 1927, from the pen of Stephen Taber. He reviews the evidence bearing on the origin of the greater features of this kind, such as the rift valleys of Africa and the Rhine, and concludes that they have not been formed by thrust faulting. Of the responsible factors he favours tension as the most important, and shows that normal faulting should be accompanied by an uptilting of the plateaux along the rims of the trough It is realised also that extrusion of lavas and increase of density of the material in depth—due in part to expulsion of gases and crystallisation—must be contributory causes in many places. There appears to be some confusion between oceanic deeps and rift valleys, but the author is wise in advocating a complete investigation of the Bartlett trough by the co-operation of geodesist, geologist, seismologist, and oceanographer.

PHOTO-ELASTICITY.—Volume 7 of Scientific Papers from the Institute of Physical and Chemical Research of Tokyo contains three papers by Mr Z. Tuzi on the properties and applications of a new material, 'phenolite, intended for photo-elastic research. It is made from phenol and formalin by the catalytic action of ammonia and is baked at 150° C. It is easily worked, takes a fine polish, is very transparent, and light yellow in colour. It breaks in tension at 300 kilograms per sq. cm., its extension being proportional to the load up to the breaking point. When examined in polarised light under stress, about 10 equal stress bands are visible before the breaking point is reached, so that it admits of a much more accurate estimate of stress than does celluloid. Its coefficient of volume expansion is 0 000564 and its heat conductivity 0 00044 at 35° C. Photographs of the stress bands are given for beams of both uniform and varying thickness when loaded and when heated to 140° C and plunged into cold water.

LIGHT QUANTA AND INTERFERENCE.—Some interference experiments with weak sources of light, which are described by A J. Dempster and H. F. Batho in the November issue of the *Physical Review*, show in a conclusive way that a single quantum of radiation has sufficient extent to produce fringes. The helium line at 4471 A was employed, as its decay constant is known from the experiments of Prof. Wien with positive rays, and its intensity was determined in each instance by comparison with the radiation from a black body. Using an echelon grating, the characteristic double order patterns which could be photographed showed that the quantum retained its

coherence after simultaneous passage through several steps, whilst with an air film between parallel plates, an even more stringent test could be imposed, which showed that a quantum follows the classical laws of reflection and transmission, and recombines afterwards with the difference in phase required by the wave theory of light

ETHER DRIFT.—The latest repetition of the Michelson-Morley experiment, which is described by K. K. Illingworth in a recent issue of the Physical Review (p. 692), has yielded a null result, no ether drift being recorded greater than one kilometre per second, the probable error of the measurements. An interferometer was used of the modified type in which one of the totally reflecting mirrors is interrupted by a small step of about one-twentieth the wave-length of green light, upon which the fringes are formed and viewed. The half-shade appearance of the line of dislocation gives an accurate means of detecting small differences in path, so that a careful untrained observer can notice a shift of less than a thousandth of a fringe. The experiments were performed in the California Institute of Technology at various times during the summer of 1927, and included runs made both under isothermal conditions and with slow progressive changes of temperature, the effect of which could be eliminated in the final analysis of the observations

A NOVEL ELECTRIC FURNACE.—A new form of electric furnace is described in the Chemiker-Zeitung of Nov. 9, which is suitable for heating quartz or porcelain combustion tubes to a temperature of 1300° C. It is mounted on rails in such a way that movements of ten to forty centimetres are possible in four directions. This enables one to remove the furnace from the hot tube and to keep it hot while the tube is cooling. The furnace is supplied by the firm Laboratoriumsbedarf Gesellschaft, Essen

THE CRYSTAL STRUCTURES OF MERCURIC AND MERCUROUS IODIDES.—An investigation of the crystal structures of the mercury includes carried out by M. L. Huggins and P. L. Magill, and published in the October number of the Journal of the American Chemical Society, confirms the previous results of other workers. Crystals of both compounds are tetragonal and the required data for the analysis were obtained from Laue and spectral photographs. In the case of mercuric 10dide, HgI<sub>2</sub>, each mercury atom is surrounded tetrahedrally by four iodine atoms each at a distance of 2.77 A., and each iodine atom by two equidistant mercury atoms. The molecules appear to be arranged in layers, and the shortest distance between two iodine atoms in different layers is 4.10 A. The crystals readily cleave parallel to the (001) faces and this is probably accounted for by the fact that the attractive forces between the layers are much weaker than those between the atoms in any one layer. Mercurous iodide, Hg<sub>2</sub>I<sub>2</sub>, is an aggregate of IHgHgI molecules, each mercury atom being surrounded by four iodine atoms and vice versa. The shortest interatomic distances are: Hg - Hg, 2.72 A.; I - I, 3.42 A., Hg-I (on same tetragonal axis), 2.75 A.

ALUMINO - SILICATES AND OXALATES. — Aluminosilicates are of considerable variety and of abundant occurrence in the mineral kingdom, and many views have been expressed as to their constitution. Recently, Prof. Walter Wahl, of Helsingfors, in a series of papers published in Finnish journals and summarised in the Zeutschrift fur Kristallographie (vol. 66), has worked out a complete analogy between these and the alumino-oxalates. He had found that certain alkali aluminium trioxalates can be split up into

optically-active enantiomorphous isomers fore becomes necessary to write a co-ordination tormula with a central sexavalent (co-ordination number of 6) aluminium atom surrounded by six (C2O4) groups, giving a complex tervalent amon In some of these complex compounds the central aluminium atom is quadrivalent (co-ordination number of 4). Replacing the oxalate groups by 'silicyl' (SiO $_3$ ) and 'disilicyl' (Si $_2$ O $_5$ ) groups, co-ordination formulæ on the same lines are written for a large number of minerals. For example, orthoclase is written shortly as  $[Al_2(S_1O_3)_2(S_1O_5)_2]K_2$  and leucite as  $[Al_2(S_1O_3)_4]K_2$ , these formulæ suggesting an explanation of the breaking down of orthoclase into leucite and silica at Polymensed formulæ for the a high temperature micas occupy almost a page of print. Silica also is not always quadrivalent in the silicates, as suggested by analogy with the fluosilicates  $[SIF_6]R'_2$ , and there may thus be isomorphous replacement of silica with co-ordination number of 6 by aluminium also with co-ordination number of 6 Such a replacement had indeed been suggested by P. A. von Bonsdorff in 1821, but this was acceptable only before the current views of valency had developed, and these it seems must now be modified.

THE 'ISOMERIC' CHLORIDES OF RUTHENIUM. The results of work carried out by J. L. Howe and described in the October issue of the Journal of the American Chemical Society, seem to dispose of two of the problems connected with the chemistry of ruthenium, namely, the apparent existence of two isomers in the K<sub>2</sub>RuCl<sub>5</sub> series and the valency of ruthenium in the blue compound formed when ruthenium solutions are treated with a strong reducing agent. It is shown that the series previously considered to be M<sub>2</sub>Ru<sup>ii</sup>Cl<sub>5</sub> is really M<sub>2</sub>Ru<sup>iv</sup>Cl<sub>5</sub>OH containing quadrivalent, instead of tervalent, ruthenium, and that the so-called 'aquo' series is actually an ordinary series of tervalent ruthenium crystallising as  $\rm M_2Ru^{m}Cl_5$  ,  $\rm H_2O.$ There are, therefore, no isomeric ruthenium chlorides, and since K<sub>2</sub>RuCl<sub>5</sub> does not exist, a possible coordination number of five can no longer be claimed for ruthenium. In all the above salts the co-ordination number is six Hydrated ruthenium oxide is usually considered to be  $\mathrm{Ru}_2\mathrm{O}_3$ .  $x\mathrm{H}_2\mathrm{O}$ , but is more probably  $\mathrm{RuO}_2$ .  $x\mathrm{H}_2\mathrm{O}$ , since in solution it always gives  $\mathrm{H}_2\mathrm{RuCl}_5\mathrm{OH}$ . When the latter substance is reduced by two units, it gives the blue solution referred to above, which, therefore, contains bivalent ruthenium, as Claus supposed.

Variation of Engine Power with Height.—The manner of variation of the power of an engine with height has been the subject of much discussion in certain scientific circles for some time. It is of fundamental importance in the reduction of aeroplane performance to a standard basis of comparison. Many investigations have been pursued to determine whether it is more accurate to regard the engine power at a definite rate of revolution as a function of the density only or of the pressure only. Recently Mr. Capon (R. and M. 1080, Aero. Research Committee. London: H.M. Stationery Office 4d. net) has suggested that the power is more precisely represented as a function of  $(pressure)^{2/3} \times (density)^{1/3}$ . In a memorandum (R. and M. 1099, Aero. Research Committee. London: H.M. Stationery Office 4d. net) entitled, "A Discussion of the Law of Variation of Engine Power with Height," Mr. Glauert reviews this whole subject and shows that the simple pressure law is undoubtedly better than the simple density law, but for greater refinement, Mr Capon's suggestion certainly gives a very close approximation to the

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## A Recent Modification of the Species-Idea.1

By Dr. A B DROOGLEEVER FORTUYN.

N view of the necessity of naming every organism, and from the fact that such a name often must be corrected when new biological facts become known, it follows that taxonomic systems are always changing Even the species-idea, which is the basis of taxonomy, The question which group of organisms is changing has a right to be called a species has been answered in different manners in different times. It seems to me that the question is always answered in agreement with the development of biology in general

Lamarck and Darwin founded the species-idea upon organs and their changes as revealed by morphology and physiology Mendel was the first to discover a means of analysing the organism through other than morphological and physiological concepts He detected the now well-known hereditary units or genes, these being the more natural units than

organs.

Because genes represented a new principle in the analysis of the organism they also came to be used as a new basis for the species-idea. This was done by Hugo de Vries in his mutation-theory, in which the existing species-idea of Lamarck and Darwin was partly changed and partly consolidated. A species from the point of view of de Vries—and I believe I may say that this is the prevalent speciesidea at the present time—is a group of organisms possessing the same hereditary qualities, the same set of genes, and thought to be genetically pure recent years the work of Johannsen and others has given us more insight into the question of what really constitutes a group of organisms that is pure in respect to heredity. Johannsen has termed groups of genetically identical organisms pure lines and a mixture of them a population. Pure lines are not the species of Nature, though they can be isolated from the latter.

We cannot define a species as a group of organisms having the same genotype,2 for it is known that often the male and the female of one species differ in the number of their chromosomes and in the number of their genes. Thus our idea of species must be wide enough to include organisms with genetical differences, as Dr. Hagedoorn and his wife, Dr. Vorstheuvel la Brand, have so ably shown in their book, "The relative Value of the Processes causing Evolution,"

The Hague, Martinus Nuhoff, 1921.

The Hagedoorns urge us to remember that a species is a natural phenomenon and not a theoretical conception. Species, as found in Nature, are mixtures of genotypes, so if we follow Johannsen and term such a mixture of genotypes a population, a species is a population, but not every population is a species. In order to be a species the individuals of a group must interbreed. Groups of organisms unable to propagate with one another do not belong to the same species. Therefore a species is a mixture of genotypes freely interbreeding and containing some types of homozygotes as well as several types of heterozygotes or hybrids.

Just because there is free interpreeding the group as a whole will have more or less constant composition and features, the type of the species. The absence of complete constancy in the character of a species doubtless renders it sometimes difficult to define, but on the other hand, as we know that species in

Nature are changing and unstable, our definition must take this fact into consideration.

Independent of the work of the Hagedoorns such ideas are rising in the minds of several investigators to-day E S Goodrich, for example ("Living Organisms," Oxford, Clarendon Press, 1924, p 151), called a species "an assemblage of closely allied and interbreeding races, differing from each other by small factorial differences, and representing as a whole its present phase of evolution" The great plasticity of such a definition of the species is obvious

So far as I know, no one has worked out this new idea of inconstant and impure species more in detail than the Hagedoorns, who have done so with much success Although a species is inconstant and genetically impure (that is, composed of many genotypes and their hybrids), it always tends to become more constant and more pure because in the struggle for existence an elimination of ill-adapted genotypes takes place, and because new genotypes may only be introduced through rare cases of mutation or of crossing with other species Therefore in accordance with the Hagedoorns we may call a species "a population which is so situated and constituted that it tends automatically to reduce its variability.

Under domestication so-called varieties exist side by side with the species to which they belong, though in Nature this is not the case. Among the spairows, for example, we find now and then a white specimen; but these albinos propagate with gray spariows and return in their offspring to the species. According to the Hagedoorns varieties do not exist outside a species, but within it. They call a variety "those individuals together which differ in some marked way from the common type, when there is nothing in the circumstances which isolates these organisms and prevents them from crossing treely with typical ones.

If a species be composed of many genotypes, the addition of one new genotype will not much alter the species. Therefore even a mutation will not always obviously change a species, but mutation remains a source for new genes and consequently for new genotypes, so it remains in this way one of the origins of species. On the other hand, new species may arise, apart from mutation and hybridisation, by mere isolation.

If a continental peninsula be transformed into an island and some members of a species originally continental thus become isolated, then the mixture of genotypes represented by the individuals on the island may be different from that obtaining among the individuals remaining on the continent. Both mixtures will move towards their own equilibrium, and therefore so long as they are isolated the island and the continent will each have its own species. These species would have arisen suddenly and without adaptation. In this way the fact may be explained that islands like the Galapagos having similar climate and conditions but being isolated from one another by deep seas have each their own closely related species of many types of animals and plants, a fact which Darwin failed to explain.

This new species-idea is of importance because it shows that there is no reason for specific discrimination among the individuals of a group freely inter-breeding. Take, for example, the house-rat. Be it presumed that from Norway to Manchuria, through Europe and Asia, all house-rats are freely inter-

From the Department of Anatomy, Peking Umon Medical College, Peking, China. Substance of a communication read before the Anatomical and Anthropological Section of the China Medical Associa-tion in Peking, September 1926.
 Genotype here means type of a set of genes, not the type of a genus.

breeding. In that case they belong to one species, Mus decimanus of Mus norregions. There is no reason to call the rat of Manchura, even it differs troug the European rat, a sub-species (Epinips norvegions caraco) or even a different species (Mus caraco) as has been done. Variation is found everywhere, for the very reason that a species is a population of many genotypes. If one wants a pure genotype one will not find it in Nature, but one may isolate it from the natural stock by breeding the rats scientifically. Therefore in research work it is often advisable either to use the impure species as such or to work with material which has been artifically and thoroughly

REISEWEG und **STATIONEN** ď FERNANDO POO in 11 PERNAMBUCO LOANDA 8 BAHLA SP FISCHBUCHT 6 WALFISCH-RIGOEJANEIRO Pro Sta Enlier Fil Lanen nung DESTERRO sm RIO GRANDE A INAPSTATO I 20 5365 II 29 4615 4 RAIRES. II 29 Ⅲ 22 5020 W 19 4060 N ₩ 49 8210 -3-VI 24 5940 VII 21 467,0 加 55 0480 5-IX 13 2180 X 18 2350 XI 16 3170 XII 16 2865 XII 22 3365 XIV 19 2580 310 Stationen « 2720 umne 310 67535 10An kerstationen @ 30°

Fig. 1 —Track and hydrographic stations of the *Meteor*. From "Die Deutsche Atlantische Expedition auf dem *Meteor*"

purified, but not with an arbitrary impure portion of the whole impure species.

A taxonomic name represents a phenotype, although it always suggests a genotype. In how far it really represents a genotype may only be detected after scientific breeding. Whether it represents a species may only be decided after a careful study in Nature of the life of the individuals indicated by the name. For these reasons palæontological names can never be proved to indicate more than phenotypes

This new species-idea is also of significance in the field of anthropology, for if mankind as a whole be freely interbreeding, then biologically speaking, mankind is only one species. It is a species so much the more because it tends to reduce its own variability by the extinction of some minor races and by other means. Pure lines are absent in man, while

hybrids, on the other hand, are numerous, because even the children of a man with brown and a woman with blue eves must be called hybrids. The groups recognised by anthropology as races certainly are heterogeneous portions of a heterogeneous whole, and then true nature cannot be fully understood without a thorough genotypical analysis.

#### Hydrography of the South Atlantic

THE cruise of the ex-gumboat Meteor terminated at Wilhelmshaven at the end of May last, after traversing 67,535 sea miles and crossing the South

Atlantic thirteen times between Africa and the South American continent. This is the only survey of the physical and chemical conditions of an ocean on such an extensive scale.

The fourth and final report of the expedition 1 shows that the programme of work, drawn up by the late Dr Mertz, has been very completely carried out, in spite of difficulties incidental to work of this nature. When the results of the observations are worked up and finally published, they will form a considerable addition to our knowledge of physical oceanography, and in all probability fundamental principles will emerge having applications of practical value Whether this happens or not, scientific exploration of this nature is an effective way of 'showing the flag,' an exceptional experience for the naval officers employed, and sound training for apprentices and seamen

Since H M S Challenger was sent m 1872 on a voyage of exploration of the conditions and life within the oceans, Germany has added much to our knowledge through the expeditions of the Valdiviu, National, Planet. Deutschland, and now of the Metcor. After the voyage of the Challenger, interest in the physical conditions of the oceans centred mainly in the drift of warm Atlantic water towards the north-west seaboard of Europe Observations, mostly by the Scandinavians, led to the inference that this moved slowly towards the Norwegian coast, the drift being stronger in some years and weaker

m others, and that these fluctuations in strength of the drift ran hand in hand with fluctuations in general weather conditions and affected the fisheries, most of which are seasonal and sometimes tail. It is to be hoped that an investigation, on a scale commensurate with the German South Atlantic Expedition, may sometime be possible in the North Atlantic, and particularly in the area to the westward of France and Ireland. A wide field for inquiry still remains open.

The report deals mostly with the programme of work carried out rather than with the results obtained. Undulatory movements in the water layers below the surface were found by A. Defant, most marked at and below the thermocline. Similar

<sup>1</sup> "Die Deutsche Atlantische Expedition auf dem Meteor" IV Bericht. Zeit. des Gesells fur Erdkunde, Berlin, 1927, Nr 5/6.

undulations have been observed by Helland-Hansen (see NATURE, Jan 1, 1927, p. 18) in the North Atlantic A use and fall of both temperature and salinity was very marked at depths between 100 and 250 metres at a position shown by an anchor on the track chart (Fig. 1) where the depth was 4350 These undulations appeared to be composed of waves having a period of about 121 hours and of shorter waves with a period of  $2\frac{1}{4}$  hours, as a

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Fig. 2 —Depths of the South Atlantic Ocean from the preliminary results of some soundings by the Meteor — From ' Die Lotungen des Meteor und die Nautik."

gross result of which the temperature at 100 metres varied between circa 22° 2 C and 24° 6 C.

A separate contribution by H. Maurer 2 deals with the preliminary results of the bathymetric survey in which some and direct sounding was employed (Fig. 2).

2 "Die Lotungen des Meteor und die Nautik" Ibel Nr 7/8

#### Larch Canker in Britain.

THERE is probably no more striking example of the assistance which the botanist, and more especially the forest botanist, can render the forester than that afforded by the lustory of the larch canker in Britain. The introduction of the European species of larch (Larix europæa) in the eighteenth century was followed by plantings, for the time, on a considerable scale. The fact that, owing to the durability and value of the wood, all sizes from an early age (e.g. for sheep-net stakes) are utilisable, resulted in the species being planted without reference to the kinds of soil it required, or, as important, in the absence of any working knowledge of the necessary thinnings which the young plantations required. Old ideas and opinions, founded on premises which lack the necessary scientific study of facts upon the ground, are difficult to eradicate.

The appearance of the larch canker (Dasyscypha

calycina Fuckel) in Britain and the devastation caused by this fungus in larch woods led to a scare in the later years of the nineteenth century. In some cases woods were so seriously infested as to justify their removal en bloc. Many others which with the knowledge of the disease now available could have been left standing, the seriously attacked trees only being felled, were cut down Worse still, larch grown in mixture with Scots pine and spiuce were ruthlessly

cut out under the mistaken idea that the fungus infection would spread In other words, that most disastrous occurrence in forestry, a 'species scare,' took place. A much saner view of the position was taken during the early years of the present century. The disease was studied out in the woods, and with the fuller knowledge obtained, many owners ruefully recognised that some of their older standing woods had been reduced in value by 50 per cent. or more owing to the wholesale removal of the larch a score of years or so earlier

Two primary causes for the widespread attack to which the larch was subjected were established: the unsuitability to the species of many of the soils or localities in which it was planted, and the excessive density of the unthinned plantations Bothwereundoubtedly contributory causes to the universal spread of the disease. It was established at the same period, however, that infected trees did not necessarily succumb to the attack; and that a young plantation of a few years' standing in which a considerable portion of the trees were infested would not die. moval of the worst of the diseased trees should be carried out, the rest being left and kept under observation. There are instances where

such plantations have completely recovered A description of this fungus and suggestions for its control are discussed in a Leaflet (No. 16) recently issued by the Foiestry Commission. It is pointed out that the European larch is chiefly affected, the more recently introduced Japanese larch (Larry leptolepsis) being seldom attacked; on the other hand, the West American larch (Larry occidentalis) appears to suffer even more than the

Under methods of control, the author of the Leaflet lays down, quite correctly, the necessity of not planting larch upon unsuitable soils. The dictum applies equally to many species, but is especially necessary in cases where a serious disease has made its appearance in the country: since the planter not only risks losing his own plantation, but his mistake also leads to the infection of neighbouring ones. On the subject of spacing, the author perhaps follows unconsciously the present policy of the Forestry Commission and advocates, in order to reduce the possibilities of attack, wide spacing in the formation of the planta-tions. "Never less than four and a half feet, or on the better sites five and a half to six feet." opinion is widely held in Great Britain at the present But it appears to be based on two fallacies. First, owing to the fact that the correct mode of thinning larch was not understood as practised in the

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past, the plantations became congested, damp, and airless, and bad attacks of canker tollowed. Secondly, the laich has always been raised in plantations from planted-out plants. Saving one or two instances only, no larch wood has originated from natural regeneration or from sown seed in Great Britain. The Leaflet in question, and many other writers, appear to assume that larch will never be raised in dense natural woods in Britain. It appears at least doubtful that this assumption is likely to prove justified. As the Leaflet shows, the life history of the fungus and the conditions it requires to thrive in are now available to all. Many of the mistakes of the past are thus avoidable Once the correct methods of thinning are applied, it is reasonable to surmise that it may be possible to raise larch in Britain as well as other species in dense young woods and thus produce a finer quality of tumber.

# Activities of Czechoslovak Engineers.

THE magnitude of engineering undertakings in Czechoslovakia is not generally realised. The publication of the "Almanac" of the seventh conference of Czechoslovak Engineers and Architects (a profusely illustrated quarto volume of 432 pages) directs attention to the achievements of its members. The greatest Czechoslovak engineering concern, the Škoda works at Pilsen, occupies an enormous area, and the history of its precursor, the firm of Laurin and Klement, shows what rapid strides have been made in the construction of engines and motors for various purposes.

In the conference proceedings three authors dwell upon the extension of the use of power alcohol, whilst other chemical engineers foreshadow the use of both old and new poison gases in future warfare

Sugar is an important item in their export trade, and an account is given of the latest practice at a number of well-known factories. The report from the Semerce Experimental Beet-growing Station also gives an idea of the progress made in improving both the crop and the sugar content of the beets.

Mladá Boleslav, in north-east Bohemia, where the conference met, is near the centre of the gem, glass, and textile industries. Reference is made to all these in the "Almanac," which lives descriptions of the garnet-cutting industry at Turnov, the glass-making at Jablonec, and the textile trade of Liberec (Reichenberg).

Another subject which received attention is long-distance telephony. The construction and equipment of stations for this work and the essentials for good transmission of speech by cable or radio were described, together with an account of the transmission stations of Prague, Brno, and Bratislava.

Technical education has not been neglected in Czechoslovakia, and the principals of a number of special schools indicated to the conference the lines upon which their work is carried on, and make mention of the good results that have accrued.

An interesting feature of the conference was that prominent industrialists and statesmen were invited to suggest in which directions they considered there was scope for improvement and further development in engineering activities and to indicate where engineers had neglected to make the necessary developments in the past. Several instructive replies are printed in the proceedings, and it may be added that they are applicable to other countries besides Czechoslovakia.

# University and Educational Intelligence.

Cambridge —Dr M Dixon, Emmanuel College, has been appointed University lecturer in biochemistry

Under the will of the Rev. J. H. Ellis a sum of about £65,000 will shortly pass to the University. The Council announces that it has given preliminary consideration to the possibility of finding from this and other sources means to provide for a substantial portion of the new University Library and for new lecture rooms for the literary faculties A detailed report will be made next term

Sn Humphry Rolleston will represent the University next May at the tercentenary celebration by the Royal College of Physicians of the publication of William Harvey's book, "De motu cordis."

London.—An ofter by the joint committee of the Paviors' Company and of the Institution of Municipal and County Engineers to establish a part-time chair of highway engineering in the University for post-graduate students has been accepted.

OXFORD.—Ceeil Graham Traquair Morison, reader in agricultural chemistry, has been elected to an official studentship at Christ Church.

John Carew Eccles, Rhodes Scholar from Melbourne, has been awarded the Francis Gotch Memorial Prize and has been elected to a junior research fellowship at Exeter College.

John Hulton Wolfenden, Proctor Travelling Fellow of 1924–5, has been appointed lecturer in chemistry at Exeter College

Stanley Carson, Fellow of New College, has been elected a member of the Committee of Geography.

New science laboratories at the City of London School were formally opened on Dec 20 with a reception by the chairman of the school committee (Mr\_Cecil F J. Jennings) and the headmaster (Rev. Dr Prebendary Chilton), followed by a conversazione to which 1500 guests were invited. The site of the school on the Victoria Embankment is probably as fine, and certainly as valuable, as that of any school in the kingdom. The penalty of eminence in this case is the difficulty of extension. The present alterations have been carried out at a cost of £22,000, and include four class rooms, a large lecture hall, a new diningroom, an armoury, and the remodelling and refurnishing of the whole of the top floor for the teaching of science All this has been accomplished without encroaching to any appreciable extent on the playground space. The new extensions were rendered necessary by recent movements in the direction of teaching science on a broader basis and to larger numbers of non-specialists. The school was one of the first to introduce natural science into its curriculum. This teaching was by 'block' lectures covering a wide range and taking in the whole school, but with very little opportunity for practical work. It has been the fashion of late to depreciate this kind of teaching; nevertheless, the fact remains that many old citizens who became famous in after life had their enthusiasm aroused and their imaginations stirred by these lectures. This, rightly or wrongly, was followed by a lectures. period of increasing specialisation for the comparative few and concurrent limitation of opportunity for the The new movement is towards a broadening of the basis for all. General science, including biology, will be taught on the classical side, physics-withchemistry on the modern side, while on the science side limited specialisation in physics, chemistry, and biology will be possible.

# Calendar of Discovery and Invention.

December 25, 1758.—Newton having stated the principles by which the orbit of a comet could be determined, Halley traced the paths of twenty-four comets which had appeared between 1337 and 1698 Finding three tracks closely resembling one another, he was led to the conclusion that the so-called three comets were but different appearances of the same comet at intervals of about 75 or 76 years Further investigation, in which he allowed for the retarding influence of Jupiter on the comet, led to the prediction of this comet's return. He knew he could not live to see it, but he wrote, "If it should return, according to our predictions, about the year 1758, impartial posterity will not refuse to acknowledge that this was first discovered by an Englishman " As the time for its reappearance drew near, its orbit was recalculated and the comet was recognised on Christmas Day, 1758

December 27, 1831. — Recommended by Prof. Henslow to Captain Fitzroy, who was about to set out in HMS Beagle to survey Patagonia, Terra del Fuego, Chile, Peru, and some of the Pacific Islands, Darwin, then twenty-two years of age, joined the expedition as naturalist, and the Beagle, after being driven back twice by gales, finally left Devonport on her famous voyage on Dec 27, 1831 The trip lasted nearly five years, the vessel reaching Falmouth

on Oct 2, 1836

December 28, 1814.—It was while serving as a government civil engineer in the Corps des Ponts et Chaussées that Fresnel, on Dec 28, 1814, wrote to a friend inquiring what was meant by the polarisation of light. The information obtained was quickly mastered, and from that time dates the beginning of his valuable studies in optics

December 28, 1895.—On a building, at 14 Boulevard des Capucines, Paris, is a tablet commemorating the first public display of a kinematograph film by the

Brothers Lumière on Dec. 28, 1895.

December 29, 1566.—Few men of science have been called upon to fight a duel, but Tycho Brahe's fight at Rostock must always remain of interest to astronomers Tycho's quarrel with his adversary, Manderupius Pasbergius, is said to have originated in a difference of opinion respecting their mathematical acquirements. The duel took place on the dark evening of Dec. 29, 1566, Tycho then being twenty years of age. In the fight Tycho lost his nose, but, as Brewster remarked, "it was fortunate for astronomy that his more valuable organs were defended by so faithful an outpost.

December 31, 1839.—Weld's "History of the Royal Society "contains some interesting notes on Herschelas great telescope, and includes." The Herschelan Telescope Song," the "Requiem of the Forty-feet Reflector at Slough," written by Sir John Herschel, "to be sung on the New Year's Eve, 1839-40, by Papa, Mama. Madame, and all the Little Bodies in the tube thereof assembled." Three of the verses ran: Three of the verses ran:

Full fifty years did he laugh at the storm, And the blast could not shake his majestic form; Now prone he lies, where he once stood high, And search'd the deep Heavens with his broad bright eye There are wonders no living wight hath seen, Which within this hollow have pictured been; Which mortal record can ne'er recall, And are known to Him only who makes them all. Here watched our father in wintry night, And his gaze hath-been fed with pre-Adamite light; While planets above him, in circular dance, Sent down on his toils a propitious glance.

# Societies and Academies.

LONDON.

Royal Society, Dec. 8 (continued from p. 902).— F. H. Constable Spectrophotometric observations on the growth of oxide films on iron, nickel, and copper The reflecting power of the metallic films increased considerably on activation, this explains the bright-ening of the oxidation colours consequent on the oxidation of the metal. The phenomenon was imitated by oxidising a cylinder of metallic copper divided into four portions, burnished, sandpapered, and two electrolytically deposited The brightness of the respective colour sequences were in the same order as the brightness of the metal surface on which they were produced. The colour sequence on copper showed strong reds and weak blues This is attributed to the strong specific reflection of red light by metallic copper. The sequence of nickel was remarkable for the absence of red colour, only browns being visible, while the dark blue was of remarkable intensity effect is attributed to the specific absorption of nickelous oxide The colours on iron are normal to blue, after which the absorption becomes so strong as to distort the sequence.

J W Lewis An experimental study of the motion of a viscous liquid contained between two coaxial cylinders. Mathematical laws deduced by G. I Taylor for the case when ratio of interspace (d) to radius  $(R_1)$  of the inner cylinder is small have been When the outer cylinder is fixed, the expression for the critical velocity at which the laminar motion gives place to vortex motion holds for values of the ratio d  $R_1$  as high as 0.71, and for liquids the coefficient of viscosity of which varies from 0.006 to 0.018 C.G.S. The determination of the critical speed can be used for the measurement of viscosities. When  $R_1\!=\!0\!\cdot\!26$  cm., and  $R_2\!=\!0.45$  cm., viscosities from  $0\!\cdot\!008$  to 0.012 C G S can be measured

with certainty to within 1 per cent

C E Inglis · Oscillations of a bridge caused by the passage of a locomotive. Mathematical methods are developed for predicting the state of oscillation set up when a given locomotive crosses a bridge at a specified speed. The author, as a member of a committee appointed in 1923 by the Department of Scientific and Industrial Research to investigate impact effects in railway bridges, had the results of practical experiment to point the way Analysis is applied in the first instance to a long-span bridge where the state of oscillation is not sufficiently violent to stimulate spring movement in the locomotive. A more comprehensive analysis, in which bridge damping and mertia effects of the moving load are taken into account, is applied to the case of an actual bridge of  $262\frac{1}{2}$  feet span. Laboratory experiments with a model bridge and locomotive were also described

G R. Goldsbrough · Tides in oceans on a rotating globe. A method is developed by which it is possible to calculate the forced tidal oscillations in an ocean, bounded by two meridians, on a rotating globe. When the ocean depth is proportional to the square of the cosme of the latitude, the determination of the semidiurnal tide is slightly simpler, and it is with this particular case that the paper is largely concerned. The method, in the case of the stated law of depth, permits of the determination of the critical depths at which synchronism with the semi-diurnal tide takes place. In an ocean bounded by two meridians 60° apart (which may be regarded as a representation of the Atlantic Ocean) the critical depth is not far from the mean depth of the Atlantic Ocean. The tides of that ocean may then be considered as arising from

E. C. S. approximate synchronism.

W F. Sheppard: The fit of a formula for discrepant observations. For testing whether a set of observations is consistent with a particular hypothesis, the accepted method is Pearson's ' $\chi^2$ ' method. The discrepancies between calculated and observed values being found in the usual way, the extent of agreement is summarised in a ratio P, which is, broadly speaking, the relative frequency of occurrence of similar or greater discrepancies in cases of the kind considered When the hypothesis involves unknown constants which have to be determined from the observations themselves, the formula is not exact. The important theorem is that, whatever (correct) method we use for finding the constants and thence deducing the discrepancies, we arrive always at the same value for P. This is the result of linear relations between sets of discrepancies found by different methods.

J. Taylor. On a photoelectric theory of sparking potentials The sparking potential is a function of potentials the photoelectric emissivity of the cathode for the radiations accompanying the neutralisation of the positive ions at the cathode surface. It is assumed that no ionisation by collision is produced by the positive ions in the gas. The validity of the theory is examined for the case of helium and good quanti-

tative agreement is obtained

C. G Darwin: Free motion in the wave mechanics Whereas previously the wave mechanics has mostly been applied to a study of stationary states, the present paper discusses its application to cases where there is a progress of events The following problems are solved: Free motion of an electron under no forces; motions of an electron in uniform electric and magnetic fields; motion of an electron in an atom; motion of an atom in a uniform magnetic field; Stern-

Gerlach effect; motion of the spinning electron A. Fowler. The spectrum of doubly ionised oxygen (O III). The paper includes a catalogue of more than 300 lines attributed to O III, of which about one-half have been classified by the author and others. As was expected, the spectrum is generally similar to that of N II, and the terms so far determined are in complete agreement with Hund's theory. The assigned term values are based upon a sequence of three singlet D terms. The deepest term is of the type  ${}^3P_0$ , and for this the value 444661 has been determined by adopting Bowen's suggestion that the well-known green lines,  $\lambda 5006$  8,  $\lambda 4958$  9, in the spectra of gaseous nebulæ are due to irregular combinations of deep terms of O III. The corresponding ionisation potential of O III is 54.88 volts.

H. Dingle: The spectrum of fluorine (F I). The spectrum F I has been investigated in the region  $\lambda$ 7600 -  $\lambda$ 8400, and the wave-lengths of 16 lines have been measured. The analysis of the spectrum previously made has been slightly modified and extended, and an approximate ionisation potential of 18 6 volts calculated. Relative term values of F 1, based on the two metastable states of the core, have been deduced

Lord Rayleigh. The line spectrum of mercury in absorption. Occurrence of the forbidden 'line \2270,  $1^{1}S_{0} - 1^{3}P_{2}$ . This line can be observed as a sharp absorption line in the unexcited vapour. The quantity of mercury required appears to be of the order 107 times as much as for the resonance line  $\lambda 2537$ 

Lord Rayleigh · Series of emission and absorption bands in the mercury spectrum. (1) The less refrangible group is situated between  $\lambda 3000$  and  $\lambda 2600$ and consists of 42 emission bands and 48 absorption bands. The emission bands are diffuse and symmetrical, without heads, and the initial spacing is 250 cm<sup>-1</sup> and point of convergence is near λ2537. The initial spacing of the absorption bands is 148 cm.-1 and the convergence point about  $\lambda 2645$  (2) The more refrangible group between \$2350 and \$2290 Under this we have (a) A series of emission bands, symmetrical, without heads, which merge into an apparently continuous spectrum ending exactly at the torbidden line  $\lambda 2270$ , spacing about 70 cm<sup>-1</sup>, (b) a series of four bands, in absorption, without heads, (c) a series of absorption bands, of finer spacing than (b) and in part superposed on the latter vergence point seems to be about λ2261 The spacing

of these bands is initially only 18 cm<sup>-1</sup>.
W. H. Taylor and J. West. The crystal structure of the chondrodite series Chondrodite, humite, and elmohumite have been examined by the rotating crystal method and by the ionisation spectrometer. Humite is based on a simple orthorhombic lattice, space group V<sup>h16</sup>, the unit cell containing four mole-Chondrodite and clinohumite are each based on a simple monoclinic lattice, space group  $C_{j,\delta}^{5}$ , the unit cell containing two molecules. The crystals bear a strong crystallographic resemblance to each other and to olivine, based on a hexagonal close-packed arrangement (somewhat expanded) of O atoms and OH groups, amongst which are distributed Mg and Si atoms, in such a way that whilst Mg atoms he within groups of 6 atoms (O or OH) each St atom is surrounded by 4 O atoms. The Mg<sub>2</sub>SiO<sub>1</sub> portion of each crystal possesses the olivine structure. All three structures may in effect be regarded as built up of alternate layers (parallel to the c face) of Mg(OH), and olivine The cementing layer of Mg(OH), has the same thickness in all, whereas the thickness of the olivine layer differs for each, the ratio of the thicknesses being that of the Mg<sub>2</sub>SiO<sub>4</sub> content of each molecule.

Physical Society, Nov. 25.-A E Knowler: On the measurement of the electrical resistance of porous The resistance of a material is measured materials independently of that at the surfaces in contact with it. The method is specially suited to the measurement of the resistance of ceramic, refractory, and building materials. Results show that the conductrivity of a building stone is nearly proportional to its moisture content. - P. K. Kichlu. Regularities in the spectrum of ionised neon. The theory of Hund is applied in tracing doublet terms and intercombinations between doublets and quartets. Almost all the lines between 2500 and 3800 have been accounted for, with a tew discrepancies -- Ezer Griffiths. A calorimeter for the determination of the heat developed by fruit. A differential arrangement is used, one container being filled with apples and the other with dummy apples of the same thermal capacity, made of thin-walled glass spheres filled with moistened glass wool. Resistance thermometers composed of 80 yards of mckel wire in glass tubes are disposed among the apples and the dummies. They are connected differentially to a slide wire, on which a difference of one thousandth of a degree causes a movement of the contact maker of 3 millimetres. The air circulation is controlled so as to maintain at will atmospheres containing from 2 to 10 per cent. of carbon dioxide around the apples The moisture content of the air before and after circulation is determined by a dew-point apparatus, and a correction applied for the heat absorbed in evaporating water from the apples At a temperature of 20° C., sound apples generate heat at the rate of about 0.012 calorie per second per kilogram of apples; or for an apple of average size (21 inches in diameter) the rate of heat generation per second is one and a half thousandth calories.

Geological Society, Nov. 30.—C. W Osman The granites of the Scilly Isles, and their relation to the Dartmoor granites. Assuming that the whole of the granites of Devon and Cornwall are due to the same cause, late adjustments of the post-Carboniferous revolution; it is shown, by comparing the two ends of the series, that the isostatic correction-sequence of intrusions is similar in both areas Previous to the intrusion of the granites the south-west of England had been subjected to three separate toldings, and the positions of the granite-laccolites are directly related to the intersection of the ridges of these folds (a) Post-Sılurıan, Caledonian folding ; (b) Post-Middle Coal-Measures, Malverman tolding, and (c) Post-Carboniferous, Armorican folding. The granite-magma crystallisation shrinkage-jointing, in regard to the production of pseudo-anticlines and synclines, is significant of direct roof-cooling influence The deeper into the laccolite the jointing is observed, the flatter the bed-joints become, as the roof-cooling influence is exhausted, until in the centre of the islands the bedding-joints are horizontal Petrological differences between the granites of Bodmin Moor and the Scilly Isles and the remainder of the south-western granites indicate a different source These two grainte-lac-colites were supplied from a great Caledonian direction-fault or series of faults parallel with, but some miles off, the north-western coast of Cornwall; only from such great faults could the allied Lundy Island granite have been intruded, all the other granitelaccolites being intruded from the Start-Lizard series of faults. The pre-granitic xenolithic inclusions in the Scilly granites indicate a great difference in age between the floor and the roof of this laccolite

#### Paris

Academy of Sciences, Nov. 21 - Charles Moureu, Charles Dufraisse, and Gérard Berchet: Researches on rubrene. pseudorubrene By the action of hydriodic acid on rubrene, iodine is set free, which suggested that a hydrogenation product of rubrene had been formed No such product could be isolated, but a substance isomeric with rubrene was obtained, named pseudorubrene The cause of the liberation of iodine has not been elucidated — Jean Baptiste Senderens and Jean Aboulenc: The decomposition of the fatty acids by sulphuric acid All the fatty acids, starting with propionic acid, are attacked by sulphuric acid at temperatures above 160° C. Details of the velocity of gas formation and analyses of the gases produced are given for various acids. It was found that the presence of a lateral chain favoured the attack by sulphuric acid—E Bataillon Polyspermia in the triton and the simultaneous cleavage into four obtained by centrifugation -Louis Roy was elected a correspondant for the section of mechanics —Félix Leprince-Ringuet The application of the method of least squares to a system of unknowns susceptible of variation -J. A. Schouten Some remarks on the geodesic deviation and similar problems.—S. Mandelbrojt: Suites of holomorph functions. Integral functions —W. Gontcharoff · Integral functions —F. Leja A property of double integral series.—Geoige Alexits. Remarks on the divergence of Fourier's series of continued functions — Krawtchouk: Analytical functions with real singularities —G Polya. The coefficients of Taylor's series —Henri Bénard. Cellular vortices and the theory of Rayleigh.—M Aubert, A Pignot, and J. Villey: The action of antidetonants on the adiabatic inflammability of hydrocarbons. Measurements of the initial temperatures necessary to obtain inflammation by adiabatic compression for mixtures of lead tetraethyl with cyclohexane, normal hexane

and normal heptane.—R Wavre. An extension of Stokes's theorem relating to figures of equilibrium. Thadée Banachiewicz. The fundamental relations of spherical polygonometry and the systems of Gauss and Delambre of spherical trigonometry —Louis do Broglie Corpuseles and  $\Psi$  waves —J  $\dot{F}$ . Saffy: The prediction of the expansibility of invar in pieces obtained by hot or cold transformation —C. Raveau: The theory of electrostriction. Criticism of a recent paper by Rocart.—G Simon Superposition rings obtained with two Fabry and Perot half-silvered plates -Henri Chrétien. The aplanatic telescope and its applications—Fred Viès, Paul Reiss, and Mile Madeleine Gex · Colouring matters changing colour in the presence of neutral salts, and the constitution of a scale of indicators with indices of variable massivity permitting the comparison of saline solutions—Pierre Chevenard The influence of the addition of chromium on the internal friction of reversible ferronickels—Pierre Brun · The dehydration of aqueous alcoholic liquids Experimental study of mixtures of water, ethyl alcohol, and isoamyl alcohol -Auguste Le Thomas The suppression of the internal strams in cast iron. The method suggested is to reheat the castings slowly to 650° C. and allow them to cool slowly -M Wilmet. The estimation of the constituents of a gas mixture containing sulphuretted hydrogen, carbon dioxide, hydrogen arsenide, hydrogen phosphide, and acetylene—Paul Baud · The use of gypsum for the manufacture of ammonium sulphate Experimental studies on the conversion of gypsum into ammonium sulphate by treating a suspension of the gypsum in ammoniacal solution with a current of carbon dioxide -J Orcel. The use of the photoelectric cell for the measurement of the reflecting power of opaque minerals. The method consists in the comparison under the microscope of the mineral to be examined with another mineral (galena, or zine blende) taken as a standard. The objective method of R Toussaint is preferable to ocular comparison, since it is free from the personal factor. Bournonite and famatinite can be readily distinguished by this apparatus—B. Dimitrievitch: A case of pseudo-polychroism of calcite—Paul Corbin and Nicolas Oulianoff · A series of rocks of supposed Carboniferous age near the Paradis des Praz, Chamonix (Aiguilles Rouges). These rocks belong entirely to the Mesozoic there are no Carboniferous strata in this locality. —Devaux The measurement of the density of snow-fields and glaciers.—R G. Werner The influence of the medium on the growth of the fungi of lichens.— Em. Miège Several special and endemic forms of Triticum dicoccum—Louis Emberger. The vegetation of the mountains of Central Morocco.—Antonin Nemec The proportion of resins in forest humus and its influence on the humification of organic materials. -R. Legendre: Application of the idea of pH to the preservation of seeds and the offals of cereals. An increase in the alkalinity reduces the hability to fermentation or germination .- E. Roubaud: The trophic preferences of Pyrausta nubilalis portance of the common wormwood (Artemisia vulgaris) as a plant for the protection of cultures. The Pyralis chooses wormwood in preference to maize and the former is not killed by the pest. It is suggested that this fact may be useful in restraining the ravages of the parasite on maize—F. Henrijean. The cardiac systole.—Fernand Mercier—The influence of sparteine on the cardiac action of adrenaline the adrenalino-sparteinic syncope.—A. Vila and R. Ancelle. The differentiation of the proteids of the blood sorum. The determination of the sulphur affords useful information for the definition of the separated fractions of the proteids It allows the purification of the two

principal proteids of the serum to be followed — Mme. Heldt: The copepods of the lake of Tunis P. I. Mezernitzky · A new method for the quantitative measurement of the effects of sun baths-Paternot, Maillet, and Rehm. An automatic ventilator for the permanent natural ventilation of rooms. A simple thermostat is connected with a damper so that the movement of the latter is a function of the temperature.

# Official Publications Received.

Memoirs of the Department of Agriculture in India Chemical Series Vol 9 No 5. Byperiments on the Feeding of Sorghum Silage and Concentrate to Senidi Calves By F J Worth and Shani Kant Misia Pp 127-133. (Calcutta Government of India Central Publication Branch) 9 annas, 10d

Memoirs of the Asiatic Society of Bengal Vol 10, No 2 Studies in Santal Medicine and connected Folklore By Rev P O Bodding Part 2 Santal Medicine Pp 131-42b (Calcutta) 10 11 rupers.

Annual Report for the Year 1926 of the South African Institute for Medical Research, Johannesburg Pp 53+2 plates (Johannesburg) City of Leicester Museum and Art Gallery. Twenty-third Report to the City Council, 1st April 1926 to 31-t March 1927 Pp 28 (Leicester) Aeronautical Research Committee Reports and Memoranda No 1972 (Ae 254) The Characteristics of certain Aerofoil Sections for Infinite Aspect Ratio. By A S Hartshom (A 3a, Aerofoils-General, 172—T 2378) Pp. 9+12 plates 3d net No 1102 (M 50). The Undercooling of some Aluminium Alloys By Dr Marie L V. Gayter Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research (A 21) Pp 24+15 plates 1s 9d net (London H M Stationery Office)

The North of Scotland College for Agriculture Report on the Work of the North of Scotland College for the Year 1926-27. Pp 35 (Aberdeen) Report of the Department of National Defence (Naval Service), Canada, for the Fiscal Year ended March 31, 1927. Pp 28 (Ottawa: F. A Acland) 10 cents

The Chemist and Druggist Diary, 1928 Pp 488+Diary. (London . 42

Acland ) 10 cents

The Chemist and Druggist Diary, 1928 Pp 488+Diary. (London, 42)
Cannon Street)

Journal of the Royal Microscopical Society Series 3, Vol. 17, Part 4,
December Pp vv+319-406. (London) 10v net.

The Journal of the Institution of Electrical Engineers Edited by P
F. Rowell Vol. 66, No. 37.2, December Pp 88+xxxiv. (London) E
and F. N Spon, Ltd.) 10s 6d. net.

Transactions of the Royal Society of Edinburgh Vol. 55, Part 2, No.
21. The Tholentes and Dolentes of the Dalmahov Synchine By Dr
Robert Campbell and Dr. James W. Luim Pp 489-505+2 plates, 3s.
Vol. 55, Part 2, No. 22. The Peripheral Innervation of the Utanus, By
Dr Amy S Fleming, Pp. 507-520. 3s. Vol. 55, Part 2, No. 23. The
Expedition to the South Pacific of the 8.Y St. George. Marine Ecology and
Coral Formations in the Panama Region, the Galapagos and Marquesas
Islands, and the Atoll of Napuka By Dr. Cyril Crossland. Pp. 531554+1 plate. 3s. (Edinburgh Robert Grant and Son., London.
Williams and Norgate, Ltd.)

Report of an Inquiry into the Relationships of Technical Education to
other Forms of Education and to Industry and Commerce. Pp. 50
(London: 29 Gordon Square.) 1s.

Report on the Teaching of the Life Sciences in the Education of Boys
and Girls of Ages 10-18. Pp. 22 (York: Friends' Guild of Teachers,
Bootham School.) 7d

The Mineral Resources of Manitoba By R. C Wallace. Second edition.
Pp. 58. (Winnipeg: Industrial Development Board of Manitoba)
Memoirs of the Department of Agriculture in India Entomological

The Mineral Resources of Manitoba By R. C Wallace. Second edition. Pp. 58. (Winnipeg: Industrial Development Board of Manitoba ) Memoirs of the Department of Agriculture in India Entomological Series, Vol 10, Nos. 1, 2 Four new Indian Gall Midges, by Dr E. P Felt, The Citrus Psylla (Duaphorina citri, Kuw ) [Psyllidae: Homopieral, by Mohammad Afzal Hussain and Duna Nath. Pp. 4+27+4 plates 1.2 rupees; 2s. Entomological Series, Vol 10, No. 4. Some new Indian Minde (Capsidae). By E Ballard. Pp. 61-68-plates 15-21 & annas, 3d Bacteriological Series, Vol. 11, No. 2. A Bacterial Soft Rot of Garden Poppy By C. S. Ram Ayyar Pp. 29-33+3 plates 5 annas; 6d. (Calcutta: Government of India Central Publication Branch ) Annals of Eugenics: a Journal for the Scientific Study of Racial Problems. Edited by Karl Pearson, assisted by Ethel M. Elderton Vol. 2, Parts 3 and 4, October Pp. 19-245-404+12 plates (London Francis Galton Laboratory for National Eugenics, University College) 35s. net.

### Diary of Societies.

# THURSDAY, DECEMBER 29

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 — Prof E N. da C. Andrade . Engines: Rules which all Engines must obey (Juvenile Christmas Lectures) (I)

#### FRIDAY, DECEMBER 30.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30.-A P. Morris. The Burmese Lacquer Industry.

# SATURDAY, DECEMBER 31.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof E. N da C. Andrade : Engines Learning about Steam (Juvenile Christmas Lectures) (II.)

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#### CONFERENCES.

DECLMBER 20 to JANUARY 6

Conference of Educational Associations (at University College) Thursday, Dec. 29, at 3—Sn Michael E Sailer — The Educational Outlook (Presidential Address)

Friday, Dec. 30, at 10 a m —Eugenies Society

At 10-30 a m —Education Guild of Great Butain and Ireland —Sn Robert Blair —The Finance of Education (Presidential Address)

At 2-30,—Joint Contenue — Linking-up in Adolescent Education (Presidential Address)

Speakers-Miss M H Meade, Mis Millington, G R Parker, and T B Tilley

At 5 30 —Order of Woodcraft Chivalry —II D Jennings-White The

At 5-30—Order of Woodcraft Chivairy—II D Jennings-White The Biological Principles of Education
At 0—International Language (Ido) Society—G H Richardson · Ido
Versification—E M Torle Radio and Ido
Satinday Dec 31, at 3 — Educational Handwork Association—A F Collins
The Place of Graft in Education

The Place of Graft in Education

At 3—School Nature Study Union—Dr F A Bather The Use of

At 5—La play House—Sociology in Education At 5—National League for Health, Materinty, and Child Welfare— occusion—School Meals and the Nutritional Requirements of Discussion School Children

School Chindre At 5-30 - British Psychological Society (Education Section).—Dr D Forsyth: Those First Five Years "Jevelay, Jan 3, at 11 am —Society for Experiment and Research in Education —J H. Whitehouse and others Some Needed Reforms in Education

Education
At 11 A m —British Broadcasting Corporation —Demonstration of Educational Broadcasting
B'educational Broadcasting
B'educsday, Jan 4, at 2 30 —Joint Conference —The Equipment of Schools.
Spatkers—T T Rees, II G Wood, and others
At 5.30 —Child Study Society—Dr D Forsyth The Effects of Bodry Infirmity on Character Formation in Childhood.
At 5 30 —British Association for Physical Training—Dr G P Crowden Physiology and Muscular Exercise.
Thursday, Jan 5, at 2 30 —Association for Education in Industry and Commerce—Some Recent Educational Experiments in Industry.
At 5.30.—London Head Teachers' Association—Rev. Hon. Dr E Lytefton The Growth of the Human Mind
Friday, Jan. 6, at 5 —King Altied School Society.—Dr Leonard Hill.
Sunshine, Open Ar, and Health.

#### JANUARY 4 TO JANUARY 9

GEOGRAPHICAL ASSOCIATION (at London School of Economics).

Wednesday, Jan. 4.—Meetings of Standing Committees
Thursday, Jan. 5, at 1130 A.M.—Dr. Marion I Newbigm: The
Geographer and the Study of Climate (Lecture)
At 5.—Sn John Russell Palestine and its Agricultural Possibilities

(Lecture)

At 6 15 .- Prof. J. F Unstead What should a Geography Teacher

At 6 16.—Plot, J. F. Unstant, what should a Geography Teacher know, and be?

Finday, Jan. 6, at 10 am - E. J. Orford and others: Discussion on The Use of Ordinance Survey Maps in Primary Schools.

At 10 am - W E. P. Betts and others: Discussion on That Geography is the Pivotal Subject in a Central School with a Commercial Bias.

At 10 A M. -V. C. Spary and others Discussion on Post-Matricula At 11 45 A.M.—Dr Vaughan Cornish (Presidential Address) Harmonies of Scenery

At 2 30 -Prof Rodwell Jones The Prante Provinces of Canada

Geographical Factors in their Economic Development (Lecture) Saturday, Jan. 7, at 10 30 A M — Major Sir E Humphrey Leggett: Beonomics and Administration in British East Africa (Lecture). Sunday, Jan. 8 (at Westminster Abbey), at 3 — Rev. Canon C. S. Woodward. International Relations in the Light of Geographical

Science.

#### JANUARY 5 AND 6.

MATHEMATICAL ASSOCIATION (at London Day Training College)

Thursday, Jan. 5, at 530.—Prof. S. Brodetsky Gravitation
Friday, Jan. 6, at 1030 a M.—President's Address: The Logical Eye and
the Mathematical Eye • their Outlook on Euclid's Theory of Proportion
At 11.30 a M.—Dr. W. F. Sheppard. What is a Partial Differential

At 11.30 A M.—Dr. W. F. Sheppard, what is a latest coefficient?

At 11.45 A M.—W. Hope-Jones: Sound-Ranging.

At 2.30 —P. Bolton: The Organisation of School Mathematics.—A W. Siddons. The Best Method of Examining School Mathematics, with special reference to the School Certificate Examination of the Oxford and Cambridge Schools Examination Board.—A. J. Taylor and others. Discussion

#### January 4, 5, and 6

SCIENCE MASTERS' ASSOCIATION (in Chemistry Department, Imperial College of Science, with Evening Meetings at Household and Social Science Department, King's College for Women).

Wednesday, Jan 4, at 8 15 PM-Sir Richard Gregory. Presidential Address

Thursday, Jan '5, at 10 45 AM —Sir J B Farmer and Capt. Irby:
Discussion—The Need of Scientific Investigators for the Agricultural
Industries Overseas

At 12.-Dr. J. W. T Walsh. Some Modern Methods in Photometry (Lecture)

Activation (Lecture).

At 11 30 A.M.—Prof. W. A. Bone: Discussion—Industrial Openings in Scientific Technology.



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#### Festivals and Survivals.

ELSEWHERE in this issue we publish the first of a series of brief notes on the calendar, which will appear from week to week in the coming year. These notes will deal with the principal fasts, feasts, and festivals of the Christian year, referring especially to the traditions, the customs, and the usages which are or have been associated with them. When possible, attention will be directed to similar observances in religions other than the Christian where these present analogies to, or serve to throw light upon, the origin and meaning of religious tradition. It is by the citation of such parallels that much in popular belief and custom, which those who in the past were curious in such matters thought merely quaint or inexplicable, has been shown to be a survival of a primitive mode of thought and a corresponding ritual. In his monumental works on early forms of religion, Sir James Frazer has interpreted the meaning of many of these periodic and seasonal observances, and he has interpreted them in such a way as to throw light on their significance in relation to the lowly as well as more highly organised beliefs. Throughout the "Golden Bough," in examples drawn from the beliefs and practices of Christian and pagan alike, there runs the central theme of the doctrine of atonement, of the sacrifice of a deity incarnate in man or animal. of the victim offered up for the salvation of the community, whether it be a community of worshippers or of subjects, and sometimes of both.

Although the more primitive peoples of to-day as we know them may be by no means so unsophisticated as they are held to be in popular belief, yet in the simpler societies the primal springs of action are more readily to be discerned. In the more complex civilisations of advanced races they are overlaid and obscured by tradition, convention, and sentiment. In all alike, however, from the lowest to the highest, in the ultimate analysis the fundamental urge is directed towards the preservation of the individual and the race. In some cases the two may conflict, as they did in the opposition of the spiritual and the material in the monasticism of the Middle Ages: in extremes both may be ignored. Given these fundamental motives in conjunction with the primitive animistic interpretation of Nature, on one side there arises from the magical ideas connected with the organs of reproduction and their function, an abhorrence of a contravention of sexual regulations in combination with a periodic unrestricted licence of orgiastic rites; on the other, many and various means are brought into operation.

especially at certain seasons of the year, to promote the fertility and prosperity of the stock or crops, and to ensure the preservation and increase of the food supply The sexual licence of a normally strict society finds its analogy in the sacrificial rite or ceremonial meal which, it has been found, at times and with some peoples, ignores the taboo of the sacred animal Nor is it enough thus to enhance actively the forces of Nature, the individual and the group must be protected from the influence, more often malign than benignant, of the spirits, whether they be conceived as of the deities or of the Hence the propitiatory rites, the funerary ceremonies, and the various means taken to drive away or ward off spirits and the ghosts of the departed. These dimly survive even to-day. All Hallow-e'en is the Feast of the Dead, we still carry the dead man from the house feet first that he may not return.

In a community as that of the British Isles, which for the greater part of its history has been predominantly dependent upon agriculture, it should not be unexpected to find customs which point to a survival of these primitive ideas. Many of the customs of the 'harvest home' are to the ordinary observer now meaningless, but when, for example, as the last load is brought in, the men are drenched with water by the women waiting for them, the rainfall which will bring fertility in the future is ensured. When in some remoter parts a few stalks of corn are still fastened together in something of the semblance of a human figure or 'dolly,' it recalls the time when the precious seed was preserved for the following season by being regarded as a material form of the deity, and invested with all his sanctity. If it were possible to attain a position of complete philosophical detachment, it would not be far-fetched to regard the mystic communion of those who partake of a ritual meal of the first fruits of the grain, which embodies the spirit of the corn, or of the sacrificial victim in the religious rites of some primitive tribe and of those who hold the extreme doctrines of the sacrament as one and the same. To-day in Italy a blend of paganism and Christianity sets up in a field after the harvest has been taken twelve little corn figures around a thirteenth, representing in the traditional form of the corn spirit our Lord and the Twelve Apostles.

The election of a King or Lord of Misrule on Twelfth Night goes back far beyond the Saturnalia, with which it is usually compared, to their common origin in the ritual unrestraint of some primitive fertility rite. In even more dramatic form the folk dance 'gathering peascods' ensures magically

a full crop by the simulation of gathering it, and the Durham sword dance perpetuates the slaughter of the king to secure in a younger successor the vigour of the community. The Abbots Bromley horned dance may date from an even remoter time when members of a hunting community wore, not ash branches, but antlers on their heads to represent the deer, thus securing the food supply by a ceremonial representation of their prey. The Witches' Sabbath, obviously a perverted fertility rite, also may go back beyond the agricultural to a pastoral stage with a six-instead of three-monthly division of the year at spring and autumn, as well as enshrine the memory of a ritual cannibalism not entirely due to a morbid popular imagination.

It is not surprising that in the earliest days of the Christian Church a rigid abstention from the rites of paganism was required of believers, an abstention they frequently failed to observe Civic duties under Roman rule or in a community largely Greek entailed performance of, or participation in, a ceremonial involving religious elements Further, in an eastern population of mixed races and religions, the desire to take part in a general merry-making is sometimes apt to overshadow differences of belief. The early Christians were forbidden even to join in the custom of an interchange of gifts on the Kalends of January; but how strong was the hold of the old gods is seen in the perpetuation of the Mother Goddess and the Veiled Artemis in the Madonna; the medieval devil still shows the cloven hoof of Pan and the horns of the woodland deities.

When the puritanical aloofness of the early Christians gave way in self-defence to a spirit of compromise, the Christian feasts and fasts were made to agree in time with those of paganism or of the old dispensation. The celebration of the birth of Christ was fixed at about the winter solstice, the time of the great feast of the god Mithra, while the Crucifixion and the Resurrection fell at the celebration of the Passover and the spring festival of other oriental religions. It was the duty of the high priest to fix the date of the Passover from observation of the moon's phases · the Church still fixes the date of Easter in relation to the same phenomenon. The coincidence of these festivals did not escape the notice of the ancients themselves, and the followers of Mithra accused the Christians of having copied their rites, while a like accusation was brought against them by the Christians It must also be remembered that, owing to their racial inheritance and their social environment, the early Christians did not differ essentially in mentality from their fellows. However far apart they stood from them

m form of observance and theological doctrine, their fundamental religious ideations had not yet diverged much from those of their contemporaries

Traces of this relationship can be seen in the theological discussions within the Church to quite a late date. Purely magical ideas abound in the writings of the Fathers and the lives of the Saints Much of medieval and still later belief—witness the doctrine of witchcraft—is essentially primitive Mathew Hopkins, the Essex witch finder, who swam a witch or weighed her against the Parish Bible, differs in method but not in kind from the South African witch doctor who 'smells out' a witch by 'throwing the bones' Witchcraft was not merely a popular superstition. Even in the seventeenth century, belief in the witch to many was a test of orthodoxy, while the doctrines of the Council of Trent contain elements which are of the purest animism, at least in form, however theological interpretation may now attempt to explain them away.

The reason for the persistence of a primitive mode of thought which we now look upon as alien to the true spirit of Christianity is not far to seek In the spread of Christianity, however strong the denunciation of paganism, a certain toleration and adaptation was the practice This was inevitable, especially in the later days of missionary effort, when a prince and all his people might be baptised en masse on one day. It was impossible that every individual, or even that any considerable number, had already been personally convinced of his or her theological error and instructed in Christian doctrine Consequently, in the remoter parts, such as Britain, Scandinavia, Central Europe, a mass of pagan beliefs and observances survived under the ægis of Christianity. Slowly and very gradually, as in succeeding ages an increasing number of individuals of stronger intellectual calibre have emancipated themselves from the trammels of tradition, ritual, and belief has been purged. But in remoter districts, in the Balkans, in Russia, among all the peasant populations of Europe, they linger to-day In the British Isles most of them have vanished, but here and there traces of a forgotten belief still remain, while of what is lost something has been recorded by gleaners of these survivals of an older faith.

The succession of racial migrations and invasions which the British Isles have witnessed has superimposed culture upon culture. These the archæologist, the ethnologist, and the folklorist seek to
recover and differentiate. For this purpose the
festivals of the calendar are one of the most fruitful sources. The ritual observances of a primitive
people being associated with their chief preoccupa-

tion, the conservation of the food supply and the propitiation of the deified forces of Nature, centre around certain crucial seasons of the year, seed time and harvest, the summer and winter solstice, and the spring and autumn equinox—Transformed and degraded, their meaning forgotten, they survive in association with certain days and seasons in the Christian calendar—So beneath our Christmas hes the Saxon—Yule—A saint's day may hide the festival of a Celtic goddess.

#### The Flow of Water.

- (1) Stream Gaging. By William Andrew Liddell. Pp xiv+238. (New York: McGraw-Hill Book Co., Inc; London. McGraw-Hill Publishing Co, Ltd, 1927) 15s net.
- (2) Hydraulics By Prof. Ernest W. Schoder and Prof. Francis M. Dawson Pp. xvi+371 (New York McGraw-Hill Book Co , Inc., London: McGraw-Hill Publishing Co., Ltd., 1927.) 17s. 6d. net
- (3) Hydraulics · a Text-book covering the Syllabuses of the B Sc (Eng.), A M.Inst.C' E, and A.M.I Mech.E Examinations in this Subject.
  By E H Lewitt. (Engineering Degree Series.)
  Pp. xii + 372. (London: Sir Isaac Pitman and Sons, Ltd, 1927) 10s. 6d. net.
- (4) Modern Waterworks Practice By F. Johnstone Taylor Pp. 272. (London . Ernest Benn, Ltd., 1927.) 18s net.

THE control of water is one of the oldest branches of civil engineering, and to-day problems connected with the flow of fluids are of first importance in connexion with many scientific and technical activities Like the engineers of ancient times, the modern engineer has to control the flow of water in canals and aqueducts; where they constructed small reservoirs, he constructs to-day reservoirs of very great capacity. ancients drew water from shallow wells by primitive means, the engineer to-day uses deep well powerdriven pumps to draw water from strata hundreds of feet below the surface of the earth. For thousands of years the power of flowing streams has been utilised to work simple machines, but to-day the rams that fall on the mountain areas are directed into channels that convey the water to machines developing tens of thousands of horse-power.

So important has a knowledge of the laws governing the control and flow of fluids become, that in the training of students of nearly all branches of engineering the subject of hydraulics, embracing the fundamental principles of hydrostatics, the flow and measurement of water and other fluids, the design of machines for the pumping of water and for the utilisation of water as a source of energy, form part of the curriculum. It is not surprising, therefore, that there is a growing body of literature dealing with particular branches of the subject, as well as with the fundamental principles of hydraulies. Of the four volumes before us, only the first can be said to meet a real need, the two books on hydraulies contain very little that cannot be found just as clearly and more logically developed in other books on the subject.

(1) Stream gauging has become a subject of real significance in the economic life of most countries. The United States, from which the first book comes, and the Dominion of Canada have for a number of years been engaged in a hydrographic survey of the water available in the natural streams, and very valuable data have been gathered as to the sources of power available, and the water available for irrigation, domestic, and manufacturing purposes. In Great Britain a good deal has been done, but in this country and in other parts of the British Empire much remains to be done, and this work, dealing with American experience, should be useful to students and to engineers concerned in the gathering and utilisation of data

Two preliminary chapters deal with the general principles of the flow of water in open channels in an elementary way, no attempt being made to justify usually accepted formulæ. In the third chapter, experimental curves (determined by Darcy and other workers) of distribution of velocity in the sections of open channels are considered; the shape of the velocity curve on a vertical section is fully discussed, and methods suggested for finding the mean velocity on a vertical section. Gauging stations and the methods of gauging streams and analysing the results are described in The defectiveness of the current meter in determining small velocities is rightly emphasised, and the student is warned of the care necessary to obtain reasonably accurate results from such instruments. The last chapter of the book deals with a subject not of great importance in Great Britain but of very great importance to Canada; the effects of ice on stream flow and on the form of the velocity curves for ice-covered streams become of very great importance when a stream is required for hydroelectric power production. An appendix is attached of fifty-two well-selected problems relating to the gauging of streams. The work forms a useful addition to the literature of an important engineering and economical subject.

(2) and (3) Both the volumes on hydraulics are written for the student That by Schoder and Dawson claims to have been written, however, "in the atmosphere of engineering activities." This volume contains matter that is found in other works on hydraulics, but, quite consistently with the real aim of the subject, it only deals with continuous flow, whether in machines or other No reference is made to the hydraulic appliances press or crane, or to reciprocating hydraulic en-The first three chapters deal gines and pumps The flow of fluids with hydrostatics and flotation through orifices is dealt with in a simple but somewhat empirical manner, there is a lack of logical development and authorities are not quoted. Useful data and references relative to submerged orifices and short tubes are, however, given

The general impression given by the book is that students in the United States approach technical subjects with insufficient mathematical preparation; otherwise it would scarcely be necessary to give detailed instruction as to how the value of  $v^2/2g$  can be obtained by means of a slide rule. The authors appear to be fearful of assuming that readers have an elementary knowledge of the fundamental principles of mechanics, and write a good deal on the flow of fluids before mentioning Bernoulli's theorem. On the other hand, the authors plunge into the use of the calculus immediately, in the chapter on flow over weirs, and use it to deduce the flow over a rectangular weir and a V notch in a manner which James Thomson and Prof. Perry years ago thought was entirely unjustifiable. It is an abuse of mathematics to integrate over an area in which the conditions do not even approximate to those assumed in the mathematical analysis. The remaining chapters dealing with flow in pipes and channels and with centrifugal pumps and turbines call for no particular comment. It is of interest to find a chapter dealing with flow of oil and gases in pipes. Revnolds's work and the criterion for similarity  $vd/\nu$  is referred to, but this is not developed very far.

The book by Lewitt bears much more the stamp of a work specially written with the examination in view, and the whole impression gathered from reading the book is that the least amount of critical study possible has been given to the subject. The only excuse, perhaps a laudable one, is that of dealing with as much as possible in a half-guinea book. As an example—a very elementary one—the usual formula  $v = \sqrt{2gH}$  for the velocity of flow through an orifice is given, and two proofs are offered without any reference whatever to the

assumptions made. The pressure and direction of motion at the section where the velocity is v is not mentioned, and there seems no escape from the unjustifiable assumption that the velocity v is the velocity through the plane of the orifice; the educational value of a critical study seems to be entirely lost. As another example of the author's unjustifiable assumptions likely to be harmful to students, reference might be made to p 304, on which is given the usual analysis of the formula of Poiseuille to determine the coefficient of viscosity It then follows that

$$\frac{mig}{v^2} = 8\left(\frac{dv}{v}\right)^{-1}$$

where m is the hydraulic mean depth of a tube and the other terms have their usual significance. Without further discussion he says, "this may be written"

$$\frac{mig}{v^2} = C \left(\frac{dv}{v}\right)^{"}$$

"where C and n are constants depending on whether the flow is stream line or turbulent." Such reasoning is entirely unjustifiable, as only by experiment is it, or can it be, known that

$$\int \left(\frac{vd}{v}\right) = \binom{vd}{v}^n$$

when the flow is turbulent.

So far as it goes the text is clear, and typical examples are worked out, but neither in order or treatment can it be said that the author adds to existing works on the subject. Following other writers, he includes a chapter on presses, cranes, etc. Unless a student knows already something of the constructional details of a single-power jigger, it is doubtful if he will gain much from the illustration on p. 342.

(4) The fourth volume, "Modern Waterworks Practice," deals very briefly with the fundamental subject matter of the second and third volumes. It naturally commences with "sources of supply." Reference is made to streams, lakes, and underground supplies, and the necessity for careful investigations before deciding upon the water available. The vexed question of compensating water is only briefly mentioned. Earthen, masonry, and reinforced concrete dams are briefly dealt with. The analysis for the buttressed dam may be right or wrong; from the reading of the text it is impossible to say, and the formulæ given must be taken on trust. The author states that the coefficient of discharge for a syphon spillway is from 0.60 to 0.65, but he gives no authority, and the statement must be taken with great reserve. The descriptions of the various types of plant found in connexion with modern waterworks are clear, though somewhat sketchy, and as a preliminary book for young engineers and students it will be valuable, but for purposes of design, other larger and more critical specialised books will need to be consulted.

# A Geography of the World.

Géographie universelle Pubhée sous la direction de P. Vidal de la Blache et L Gallois. Tome 1: Les Îles Britanniques. Par Prof. A. Demangeon. Pp. viii + 320 + 56 planches 80 francs.
 Tome 2: Belgique, Pays-Bas, Luxembourg. Par Prof A. Demangeon. Pp. iii + 250 + 40 planches 60 francs (Paris: Armand Colin, 1927.)

THIS work, of which the first two volumes have now been published, was planned some fifteen years ago, and was already in active preparation when the European War intervened. When work on it was resumed, the originator and editor, M. Vidal de la Blache, had died, but the project was carried through by M. L. Gallois on the lines that had been laid down. The facts of geography are not new, but the geographer can view them at a fresh angle, and this book is an excellent example of how the geographical outlook, with its selection and correlation of facts and linking of cause and effect, can illuminate the description of a country.

(1) Prof. A Demangeon, in his volume on the British Isles, has given the best account of the geography of this country that has yet appeared. It is not so full as some regional monographs, but it gains in being more vivid, and the picture of the whole is never dimmed by tedious detail. Not only is he comprehensive in his treatment and accurate in his facts, but also he writes with a clear understanding of the attributes and distinctions of the various parts of the country. We can recall nothing in English that is equally successful in portraying and explaining the scenery of Britain and the life of its people.

A book so packed with facts and venturing frequently on estimates of human and social characteristics might well lend itself to easy criticism. But the reverse is true. There is little that one who knows intimately most parts of the British Isles can find fault with. Prof. Demangeon's command of facts is equalled only by his balanced judgment. Some of his chapters on the landscape and its origin also show great descriptive power. We would commend particularly the chapters on

Scotland, with their intimate study of Edinburgh's traits and his long chapter on London, its origin, growth, and life.

One of the few omissions of any significance is an apparent neglect of the port of Immingham, perhaps because its statistics are generally combined with those of Grimsby Dundee has now no whalers left, and Leith is the only whaling port in Britain. Mention might be made of the part that the granite industry played in the fortunes of Aberdeen. Bibliographies are attached to each chapter. On the whole, they are good, even if a few entries might be replaced by more modern books and a few somewhat trivial books omitted. There is a full index of place names. The illustrations are well chosen and are of real value.

(2) The second volume, on Belgium and Holland, maintains the same high standard and is particularly interesting in its account of the struggle against the encroachment of the sea and the scheme now in progress for the partial reclamation of the Zuider Zee. The complete work in fifteen volumes is to cover the whole world.

R N. R. B.

# Agricultural Education and Research.

Ministry of Agriculture and Fisheries: Intelligence Department. Report on the Work of the Intelligence Department of the Ministry for the Two Years 1924-26. Pp. 86. (London: HM. Stationery Office, 1927.) 2s. 6d net.

IMMEDIATELY after the War there was manifested a great enthusiasm for research in nearly all the branches of science, and in agriculture, where the relation of pure science to the applied branches and to the practice of the field is a very close one, there was launched a number of comprehensive schemes both for the pursuit of knowledge and for its dissemination throughout the agricultural community. The time has now arrived when it is possible to view the good first fruits of some of these schemes and to say au revoir to others which have been found impracticable, or were born before their time.

It is eminently satisfactory to find that so much of the original planning has survived the stringent test of action and that the foundations and footings of a great and progressive agricultural service have been established. This service owes a very great deal to the ability and breadth of view of one man, and as it grows and produces its results, not only in Great Britain but also throughout the British Empire, the great work of Sir Daniel Hall will be

made manifest As chief scientific adviser to the Ministry of Agriculture it has been his business to select from the inchoate mass of suggestions, inferences, and wild-cat schemes and to build up a working plan which would cover the needs of fundamental research, agricultural education, and advisory work among farmers, and the terms of the report of the Intelligence Department of the Ministry of Agriculture before us make clear a measure of his success

Such work and such organisation have required the expenditure of very large sums of money, by far the greater part of which has come from the public purse, but, to take a single year as an example, it is reassuring to find that the £700,000 spent in 1925 on agricultural education and research is equivalent only to 0·3 per cent of the annual production of the land of England and Wales.

The research institutes, each with its own department of interest, make possible the carrying through of necessary fundamental work in the increase of knowledge and at the same time give the necessary agricultural bias to the scientific facts evolved. Ideally, they should pursue pure science, with a lively consciousness of the agricultural background which must colour their work in the public view. Actually, they vary very much in their regard for pure and applied science and in their appreciation of the fundamental and ad hoc problems presented to them

One of the great difficulties which has been encountered in the past few years has been the supply of men with two sides to their heads, and capable of appreciating at once both the scientific problems presented in pure research and the bearing which these must have upon practical agriculture. This difficulty has been greater, perhaps, in the recruitment of the advisory services than in the research institutes, but it has been encountered in both spheres, and it has often made difficult the maintenance of understanding and sympathy as between laboratory and field workers.

The universities so far have not been entirely successful in producing a supply of research workers who, in addition to possessing a wide view of their subject, are able to think in terms of action. The tendency to strict specialisation in research work is necessarily very great, but there would surely be a great advantage to the agricultural service in general if the young men coming from the universities were compelled to obtain actual field training in some department of an ordinary farm before being allowed to settle down into their allotted groove of work.

Students from Scotland and the north of England have a considerable advantage over the southerners, in that a very large number of them have had to work on the land in their early days, and this may perhaps account for the very large percentage of northerners in the research and advisory services. The provision of scholarships, rich enough to attract really able young men of all classes, and the construction of a sort of ladder by which a bright boy can climb from the village school to the greatest of our universities, via such places as farm institutes and agricultural colleges, has helped the supply of men, but there is still much to be done.

One of the greatest difficulties encountered in the agriculture of the past has been that of the exchange of ideas between experienced agriculturists and the dissemination of trustworthy information. It is almost proverbial that the link between the laboratory and the farmer is a very weak one, and it is therefore all the more satisfactory to find that the agricultural advisory service continues to grow both in numbers and in the good graces of the farmers themselves

The change in this department in the past twenty years is very remarkable. In 1907 there were scarcely any county organisers and only a few lecturers, and they were regarded with the utmost suspicion by the farmers of their districts A few outstanding characters earned for themselves reputations for wisdom and soundness, but it was done by force of personality rather than learning. To quote a well-known agricultural adviser addressing a meeting of his colleagues recently "Twenty years ago no self-respecting farmer would be seen speaking to an organiser, while now they seek you out in the market and, what is more, do what you tell them " There has been a great change of heart, and the present generation of farmers is anxious to learn, and is not convinced that the law of the grandfathers is immutable.

The organisation of the framework of the advisory system is almost complete over the country, and the supply of trustworthy information to farmers on almost every subject connected with their business is assured. It remains now for the advisers themselves and the farmers to take full advantage of the inquiring spirit of the age and of the opportunity which is offered. We, especially those of us who are farmers, have been apt to regard our own coasts as the limit of our concern and interest. This parochial view is shaken daily by the closer contacts in the market and in conclave with other parts of the British Empire, and it is

interesting to find that our home advisory service is being depleted of some of its best young men by the creation of attractive posts for them overseas An Empire Marketing Board, an Imperial Research Conference, a common pool of research workers and advisers—it seems that agricultural science progressive and well organised is about to take its proper place as one of the dominating influences in the development and progress of the Empire

CLEMENT HEIGHAM

#### Our Bookshelf.

Histoire des bois et forêts de Belgique: Des origines à la fin du régime autrichien Par le Comte Goblet d'Alviella. Tome 1 Pp. xvi + 490 + 18 planches. Tome 2 Pp xii + 350 + 16 planches Tome 3. Pp. ii + 140. (Paris Paul Lechevalier, Bruxelles: Maurice Lamertin, 1927) 3 vols. 100 francs.

A COMPLETE history of the forests of Belgium from the earliest times up to the end of the eighteenth century is given in these three volumes, which embody the results of much learned research The economic and social importance of the forests throughout the ages is the main subject of the work, but much light is also thrown on the natural history of the woodlands and on the gradual but late development of scientific sylviculture and forest management. Folk-lore, legislation, charters, archives, ancient MSS., classical writings, and modern books have all been laid under contribu-An agreeable feature of the work is the high quality of the full-page illustrations, which reproduce famous landscape pictures, maps, plans, and photographs

A great variety of information is scattered throughout the work. In every period much destruction of the original forests has taken place. The early natives and their Roman masters regarded the forests as mexhaustible, and ruthlessly plundered them for fuel and timber. Increasing population necessitated more agriculture for its support, and this was only to be obtained by encroachment on the land covered with trees. From the sixth century onwards, the civilising Benedictine monks, in their zeal for farming, were probably more destructive of woodland than the early pagans The forests that now exist in Belgium and France owe their preservation throughout the Middle Ages to the feudal lords, who loved the chase, and instituted severe game laws, depriving the peasants of their rights to fell timber and pasture their flocks in the forests. The sites of the ruined forests can often be recognised in the modern names of villages and communes. Ypres was so called on account of the elms (yppen in Flemish) which were numerous in the woodland where the town was first built In the years before the War, the country around Ypres was still noted for its numerous fine elms, which were survivors and descendants of the trees in the original virgin

Lectures on Dielectric Theory and Insulation. By Dr. J. B. Whitehead Pp vii+154 (London McGraw-Hill Publishing Co, Ltd., New York McGraw-Hill Book Co, Inc., 1927) 12s. 6d net

PROF. J. B WHITEHEAD, who is professor of electrical engineering at the Johns Hopkins University, has done much valuable research on insulating materials. During 1926–27, when he was an exchange professor in France, he gave a series of lectures on the properties of dielectrics and the phenomena which occur when high electric stress is applied to insulating materials. These lectures he now publishes in book form, and they will be very helpful to physicists and particularly to electrical engineers.

In the first lecture, Prof. Whitehead gives a brief and accurate account of the more important postulates which have been made in the classical theory of perfect dielectrics. Most of the material in the following seven lectures is taken from recent papers on physics and electrical engineering. The results, however, have been co-ordinated and they are presented in a way which will be appreciated by those engaged in research. The author points out the most promising directions for further research. The last chapter is devoted to researches on the properties of composite insulating materials when subjected to very high electric stresses. In this chapter he incorporates many of his own researches on these materials when subjected to high alternating stresses. In conclusion, a very complete bibliography of the subject has been given. It is arranged under six general headings, and we have found it useful.

Bacterial Vaccines and their Position in Therapeutics. By Prof. Leonard S. Dudgeon. (Modern Medical Monographs, edited by Prof. Hugh Maclean.) Pp. vii + 87. (London. Constable and Co., Ltd., 1927.) 7s. 6d. net.

This book is essentially a record of the personal opinions of the author after an extensive experience of twenty years on the preparation and use of prophylactic and therapeutic vaccines in different diseases. Rabies and vaccinia are included, although not strictly bacterial, but prophylaxis by means of diphtheria toxin, and Dick's scarlatina toxin, are omitted Very few diseases are included for which the author has not himself used vaccines. Much sound and valuable advice is given about the kind of case in which vaccines should be avoided or only given with great caution. For the rest, the advice, if rather conventional and based on almost purely empirical clinical grounds, is backed by experience and free from the uncritical and dangerous optimism of many treatises on the subject. Prof. Dudgeon is adverse to the treatment of acute general infections by vaccines. The more recent advances in the theory of prophylactic vaccines and bacterial antigens are unnoticed, and in this the author consistently adheres to his policy of dealing only with what he himself has tried for a long period. No reasons are given in support of the use of therapeutic vaccines beyond the author's personal belief in their efficacy, and no new experimental evidence is adduced.

Hippokrates · eine Auslese seiner Gedanken über den gesunden und kranken Menschen und über die Heilkunst Sinngemass verdeutscht und gemeinverstandlich erlautert von Dr. Arnold Sack Pp. vi +87. (Berlin. Julius Springer, 1927) 3 60 gold marks.

In this booklet, Dr Arnold Sack, of Heidelberg, has made a judicious selection of the most important passages in the works of Hippocrates and rendered them into readable German—The passages selected include the oath, and extracts among others from the law, the surgery, the epidemics, airs, waters, and places, the prognostics, dentition of infants. nature of man, care of health, and numerous aphorisms

In the postscript, Dr. Sack maintains that though nothing definite is known about the life of Hippocrates, it is certain that he was not a mythical personage, but really did exist, as is shown by allusions to him in Plato's dialogues, and not only practised medicine but also wrote medical works. It was not until many centuries after his time that commentators of the Hippocratic works appeared in Alexandria, Athens, and Rome, the most prominent of whom were Galen and Herophilus No critic has yet been able to determine with certainty which of these works was written by Hippocrates himself and which by his pupils. It is, therefore, not surprising that some of the passages selected by Dr. Sack are from works regarded by other commentators as spurious

Finlayson's Clinical Manual for the Study of Medical Cases. The fourth edition Edited by Dr. Carl H. Browning, Dr. E. P. Catheart, and Dr. Leonard Findlay; revised and augmented throughout by various contributors. Pp. xvi + 815 + 4 plates. (London. G. Bell and Sons, Ltd, 1926) 18s. net

Many physicians and students will greet with pleasure the publication, after an interval of thirtyfive years, of a new edition of "Finlayson's Clinical Manual" The great progress made in all branches of medicine, and particularly in diagnostic methods, has necessitated the complete revision of some parts of the book and the inclusion of much that is entirely new, but the general plan of the original has been retained, and there has been no departure from the principles of medical training indicated by the late Dr. Finlayson. The student is still taught the prime importance of observation at the bedside, first and mainly with his eyes, next with the hands, and last and least with the ears Laboratory methods, however, are not neglected. The technique of reactions which come only within the sphere of the bio-chemist is naturally omitted, but full details are given concerning investigations of general value, including recently evolved tests such as that of van den Bergh. The manual contains useful tables and a very complete index, and there is no doubt that this edition will be as popular as were its predecessors.

#### Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

#### The 'Palæolithic Implements' from Sligo.

WE have read the reply of Messrs. Reid Moir and Burchell, published in NATURE of Nov. 26, to our letter on the above subject. We note that we or our observations are old-fashioned, unwise, faulty, mistaken, abortive, dogmatic, and so forth; but we find little or no serious attempt to meet the main points of our criticisms, and we are so "unscientific" as to

hold that detraction is not argument.

Messrs. Reid Moir and Burchell specified three sites as sources of their 'implements.' They admit by implication that we identified two of these; for they make no effort to question any of our statements regarding them The third, they suggest, we "failed to observe" This is not the case; and their suggestion, based as it is upon an ambiguity of topographical nomenclature, is scarcely ingenuous. The squareheaded promontory of carboniferous limestone, south of Drumcliff Bay, comprises the townlands of Upper and Lower Rosses. In some of the older maps only the north-western angle of the promontory is called Rosses Point: but in current modern usage this name has been extended far beyond that narrow application, to which Messrs. Reid Moir and Burchell now wish to confine it. The village, church, post-office, hotels, etc., of Rosses Point all lie along the south coast of the promontory, one to two nules distant from the northwestern angle. Those unacquainted with the district can verify this by reference to any recent map, such as the six- or one-inch Ordnance, Bartholomew's quarter-inch, the Admiralty Chart, etc. Knowing this, and assuming that Mr. Burchell also knew it—as we think he must have done—we covered with our survey the "western or seaward side" of the whole promontory, including the north-western angle; with the results stated in our first letter. We have there already mentioned the only features, along the strip of coast in question, to which the term 'rock-shelter,' fallen-in or not, could by any stretch of imagination be applied; or to which Mr. Burchell's ambiguous indications could in reason be referred.

At this north-western angle, where we now learn definitely that Mr. Burchell's 'rock-shelter' is situated, we found only an ordinary storm-beach, composed of angular blocks derived from the rocks around it; and limited, as to its dimensions, by the nature of the ground, the character of the rocks, and the manner of their erosion. As there can now be no doubt that this is what Mr. Burchell claims to be a fallen-in rock-shelter, it becomes necessary to de-

scribe it with some particularity.

The beds of limestone referred to dip at a low angle towards the north-west. At the spot where the 'rock-shelter' is situated three beds are present. The *upper*, evidently the 'roof' of the 'rock-shelter,' is formed of a very cherty, much jointed grey limestone, and is about 2 feet thick. The *middle*, which is about 4 feet thick, consists of more thinly bedded grey limestone, almost devoid of chert. The *lower*, the 'floor' of the 'shelter,' is a more massive and compact limestone, brownish on the surface, quite devoid of chert, and easily distinguished from the other two.

The middle bed yields to marine erosion a little

more rapidly than either of the others. In consequence, undercutting of the upper bed is continually in progress; but, owing to its strong jointing, blocks fall away from it before there is any marked overhang. For this reason it is impossible that it could ever have formed a roof capable of giving shelter. The erosion of the middle bed exposes the lower bed, and from this latter rather large blocks, sometimes as much as three or four feet in length, become detached from time to time, and are cast up to a higher level by the winter waves. The erosion of the three beds thus advances, to all intents and purposes, concurrently.

The resulting storm-beach covers the whole area of the alleged 'rock-shelter'; and its dimensions agree with those of the 'shelter,' as given by Mr Burchell. But of the blocks which compose it, only about one-third come from the cherty upper bed (the 'roof') the other two-thirds come mainly from the lower bed (the 'floor'), having been cast up by the waves to a height several feet above their original position, so that they overhe some of the smaller debris.

The middle bed breaks up more readily into small pieces, with angular fractures. Many of these fragments are so recently broken that they have not yet been rolled by the waves, though some of them display chipped edges, produced by marine action. Stormwaves have free access to this material, as is shown by the copious admixture of recent marine shells associated with it—some of the bivalves being so fresh that they still retain their ligament. This mixture of stones and shells lies around and beneath the larger blocks; and it is from this material that Mr. Burchell's 'implements' have been selected.

The suggestion that this mass of rock debris could have formed the roof and contents of a Palæolithic rock-shelter would have appeared to us so ludicrous, had it so much as occurred to us, that we should have dismissed it forthwith. Since the publication of Messrs. Moir and Burchell's most recent letter, definitely indicating this spot as the site of their rock-shelter, two of us have revisited the place and reexamined it with care. Their report confirms us in our former conclusion—that it presents nothing more than a typical storm-beach, similar to those that are to be seen on Coney Island and at other places in the

neighbourhood.

After this second, more thorough examination, we are now able to say that in spite of Mr. Burchell's depredations it would still be possible to select, from among these fragments, specimens presenting a very passable resemblance to implements. There would be no difficulty also in finding among them shapeless lumps of stone which the most sanguine could never mistake for artificial products. If these two groups were laid out at a short distance apart, we might, with no very great expenditure of time and trouble, fill in the space between them with a complete senation of forms, gradually approximating from the one to the other. Even without the advantage of seeing Mr. Burchell's carefully chosen specimens, we can well believe that they look very convincing on the table of the Society of Antiquaries: but we suspect that they would be less impressive if they were lying where the last storms left them, mingled with these countless intermediate forms and with modern seashells.

Mr. Burchell's "Raised Beach of powdered shells" can be readily seen in the earthy bank just behind his 'rock-shelter,' though his reason for calling it 'Early Neolithic' is less obvious. It is a mere upward extension of the recent beach, and is likewise due to storm action, probably within the last century or two. The lighter fragments have been

projected by spray and wind farther than the heavier ones—that is the only difference which this upper edge of the beach presents in contrast to the lower part. The shells are of species now common in the bay, including Solen siliqua (predominating), Venus gallina, Cardium edule, Donax vittatus, Mytilus edulis, Ostica edulis, they occur in the same relative proportion from the highest point of the so-called 'raised beach' down to the lowest point of the present heach.

By quoting in support of their case a reference from the Geological Survey Memoir to a raised beach at Carney, Messrs. Moir and Burchell show themselves to be unaware that the study of Irish raised beaches has progressed within the forty years which have elapsed since that memoir was published. The Carney 'raised beach' is wrongly so described; it consists of shelly deposits, due either to recent storm action or to human agency. Similar shelly beds are frequent along the Irish west coast, as in Counties Mayo, Galway, and Clare. Those of human origin date, some from the famine year (1847), some earlier, some later. The well-known 25-ft. beach of Northern Ireland, so conspicuous in the north-east, drops to sea-level and merges with the present beach in Co Wicklow in the east, and Co. Sligo in the west, as is well shown in Wright's "Quaternary Ice Age," p. 422, Fig. 151. We repeat: No raised beach is known within this area.

If they had realised it, we were doing Messrs Moir and Burchell a service in pointing out their error in this matter. For, under the conditions prevailing on this spot, a Neolithic raised beach overlying a Palæolithic rock-shelter, such as Mr. Burchell describes, would be damning evidence against his We invite a consideration of what it would claims. (1) A rock-shelter formed by marine action in strongly jointed and bedded limestone, on very exposed ground, with (2) Mousterian implements on its floor; (3) heavy glacial erosion of the district; (4) submergence, until a beach was deposited above its roof; (5) emergence, until its floor was a few feet above ordinary high-water mark, (6) recent constal erosion, postulating more rapid crosion during the two preceding phases; and (7) after all these vicissitudes, the rock-shelter still surviving, save for blocks fallen from the roof, and still retaining exposed on its floor "more than 100 unrolled flakes and flake implements made of limestone"! (The italics are ours.)

Messrs. Reid Moir and Burchell complain that we prejudged the authenticity of the material removed to London without having examined it. If they will refer to our previous letter they will see that we were careful to avoid doing this. They also charge us with a desire to maintain at all costs a preconceived theory of the absence of Palæolithic remains from Ireland. Personalities of this kind possess neither interest nor importance, and are best ignored: but we may permit ourselves to say that here also they make a statement contrary to fact. We are ready to welcome any discovery of Palæolithic man in Ireland, by whomsoever made. We visited Rosses Point with perfectly open minds. Had we found that the sites agreed with Mr. Burchell's description, we should naturally have endeavoured to follow up our inspection of the ground with an examination of his collection. But the geological evidence proved so destructive that we considered that no useful purpose would be served by a journey to London, until the difficulties presented by the nature of the sites had been cleared This, we repeat, Messrs. Moir and Burchell have made no serious effort to do: accordingly our case rests where it did.

Much more might be said on other points that have

been raised in this correspondence: but we do not propose to trespass further on the hospitable columns of Nature, unless some new statement of fact be made, which in our opinion calls for notice. Just as a sentence removed from its context can convey a surprisingly false impression, so the Sligo 'palæoliths,' brought to notice by Messrs. Roid Moir and Burchell, cannot be fairly and fully judged without a competent study of the sites that yielded them.

R A. S. MACALISTER

J. KAYE CHARLESWORTH.

R. LLOYD PRAEGER. A. W. STELFOX.

Dublin, Dec. 5.

# Thermodynamics, Wave-theory, and the Compton Effect.

Prof. A. H. Compton's own explanation of the remarkable phenomenon discovered by him is well known and is set out very clearly in his recent book on "X-rays and Electrons." Briefly, it is that radiation is of a corpuscular nature, that the momentum of the impinging quantum detaches the electron from the atom and causes it to recoil, while the deviated quantum loses energy in the process and degrades in frequency. This view of the Compton effect, like Einstein's explanation of the emission of photoelectrons, approaches the relations between matter and radiation from a point of view so divergent from that of the familiar concepts of Maxwellian electrodynamics, that it is scarcely possible to understand how this conception of radiation is physically reconcilable with the familiar explanations of interference and diffraction phenomena.

As is well known, there is an addition to the X-ray scattering of degraded frequency, an unmodified secondary radiation the existence of which has been explained by Prof Compton as due to the whole group of electrons in the atom scattering conjointly. To this view, the objection might be raised that if one electron acting alone can scatter a quantum, and also all the Z electrons in the atom acting together, then why do we not observe scattering by two, three, or more electrons acting together at a time, with their corresponding fractional Compton shifts in wavelength? To the alternative explanation of the un-modified scattering given by Profs. Compton and Jauncey that it represents the scattering by an electron which the impinging quantum is unable to detach from the atom, the equally pertinent query may be asked, then why is the intensity of this type of radiation proportional to  $Z^2$  and not to Z?

In addition to these objections to Prof. Compton's explanations of his own discovery, there is another of a very fundamental nature which was also urged by me when, by invitation, I spoke at the British Association meeting at Toronto in August 1924, on the problems of the scattering of radiation. Maxwell's theory of light not only explains the classical phenomena of interference and diffraction, but also, when taken in conjunction with the principles of thermodynamics, affords a very complete explanation of the phenomena of the scattering of ordinary light in gases, liquids, and crystals under the widest range of physical conditions. This has been fully demonstrated by me and my associates in a series of experimental and theoretical researches during the last six years. Is it conceivable, then, that Maxwell's theory and thermodynamics taken together would fail in the closely alhed field of X-ray research? Urging this point of view, I referred at the Toronto meeting to the beautifully simple explanation which the classical wave-theory and thermodynamics together give of the X-ray diffraction haloes in liquids.

During the current year I have returned to this subject, and in a series of memoirs which are being published in the Indian Journal of Physics, have developed a general theory of X-ray diffraction and scattering in which theimodynamics, the classical wave-principles and modern views of atomic structure are brought together and shown to afford a simple and intelligible explanation, not only of Prof. Compton's own discovery, but also of the crucial experiments of Bothe and Geiger, and of Compton and Simon, which at first sight seem so destructive of the classical wave-ideas. It is not possible in the columns of Nature to afford more than the briefest indication of the line of thought followed in these memoirs

The facts of temperature radiation from solids and fluids compel us to assume that the thermal agitation of bodies excites not only the atoms but also the electrons contained in them. Starting from this premise, it is shown on Maxwellian wave-principles

that we must have two types of secondary X-radiation, one of intensity proportional to Z² which corresponds to the normal or stationary state of the atom, and the other proportional to Z produced by the thermal fluctuations of the internal structure of the atom. The former is a stationary or diffraction effect, and the latter is of a highly fluctuating type, the intensity of which has no fixed values at any time or place and the laws of which can only be formulated as statistical relationships. This type of scattering is identifiable with the Compton effect, and the observed variations of the latter with direction of observation, atomic weight of scattering atoms and wave-length of X-rays, and the observed fluctuations with respect to time and direction, are all satisfactorily explained.

In addition to these, the theory indicates that as the Compton effect is essentially a thermodynamic phenomenon involving degradation of energy, it should show a marked dependence on temperature. Experiments to verify this are in progress at

Calcutta, but there are already sufficient indications in the literature of X-ray scattering and absorption and their variations with temperature to indicate that the success of the experiments is a foregone conclusion. The results of the experimental work will also be published in the *Indian Journal of Physics*.

C. V. RAMAN.

210 Bowbazar Street, Calcutta, Nov. 10.

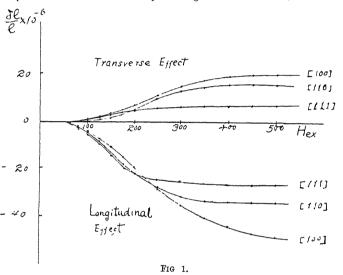
# The Magnetic Properties of Single Crystals of Nickel.

Last year Dr. Honda and the present writers published a paper dealing with the magnetic properties of single crystals of iron (Nature, 117, 753; 1926). The present paper contains the result of the similar investigations on nickel. In order to obtain large crystals of nickel, a strained bar of electrolytic nickel melted in vacuo was continuously heated at 1300° C. for several days, but the result was the formation of twinning crystals of several millimetres in length and no further growth took place. In the second trial, molten metal was cooled from the bottom of the crucible containing it by slowly lowering the vessel out of an electric furnace; in this way we were able

to prepare large crystals of nickel, 7 cm. in length and 2.3 cm. in diameter.

From these crystals three oblate ellipsoids, the flat planes of which coincided respectively with three principal planes (100), (110), and (111), were prepared. The major axes of the ellipsoids were about 20 mm, and the minor axes 0 6 mm. The processes of sawing and filing were always done by hand very carefully so as to avoid the least distortion of the crystal.

The results of the measurement of the magnetisation in the direction of the principal axes of the crystal are shown in Fig. 1. As is seen in the figure, the magnetisation curves in the directions of the tetragonal, digonal, and trigonal axes are almost straight, and coincide with each other up to an intensity of magnetisation of 205. Above this intensity the magnetisation varies for the different axes of the crystal, the trigonal, digonal, and tetragonal axes showing a decreasing order of magnetisability. This is just the reverse of the case of iron crystal. The saturation intensity of magnetisation is 503, which is



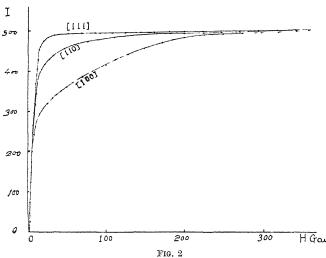
higher by 5 per cent. than the value 478 obtained by P. Weiss, and lower by 1 per cent. than the value 509 determined by E. Gumlich.

In plane (100), both parallel and perpendicular components of magnetisation in a constant field vary with a period of 90°. For the parallel component, the direction of the digonal axis has the maximum magnetisation, and that of the tetragonal axis the minimum magnetisation; but for the perpendicular component, the magnetisation vanishes in the direction of the tetragonal and digonal axes and attains a maximum or minimum between them. When the intensity of the magnetic field increases, the amplitude of these periodic changes increases, attains a maximum, and afterwards gradually decreases. The above periodic change coincides qualitatively with the case of iron crystal, when the direction of its principal axis is supposed to be rotated by 45°; this difference may be expected from that of the lattices in (100) plane for iron and nickel crystals.

In plane (110), two components of magnetisation vary with a period of 180°. For the parallel component, the principal and secondary minima take place respectively in the directions of the tetragonal and digonal axes, and the maximum in the direction of the trigonal axis.

In plane (111), the two components of magnetisation

vary with a period of 60°. The amplitude of these periodic changes is very small, not exceeding 4, which is only 4 per cent, of the maximum amplitude in the plane (110). In a weak field, the parallel component of magnetisation in the direction of the side of the equilateral triangle forming the space-lattice is a minimum, and that in the direction of the bisectors of the vertical angle of the triangle is a maximum; but in a stronger field the opposite is the case. These relations coincide qualitatively with the case of the (111) plane in the iron crystal when the direction of the principal axis is rotated through 30°.



The magnetic expansion-field curves for the directions of tetragonal, trigonal, and digonal axes are shown in Fig. 2. In the case of the longitudinal effect, magnetic contraction is observable for all fields, while in the case of the transverse effect, magnetic expansion is always observable. In both cases tetragonal, digonal, and trigonal axes are in the descending order for magnetic expansion or contraction; thus the order is just the reverse of the magnetisability.

Seisi Kaya.

Yoshio Masiyama.

Research Institute for Iron, Steel, and other Metals, Sendai, Japan.

# New Methods of Electrically Maintaining Mechanical Oscillations.

In the article on radio-frequency measurements in Glazebrock's "Dictionary of Applied Physics" (vol. 2, p. 635), Dye states that "quite powerful longitudinal vibrations in steel bars can be produced by acting on them with currents of the resonating frequency." From conversation with Dr. Dye, I gather that this refers to some otherwise unpublished work in which the oscillations are maintained by electric, that is, electrostatic, forces derived from an oscillating valve set and a polarising battery.

Experiments made by me on audio-frequency oscillations of metal rods under electric forces from a valve show that these vibrations can be obtained of great intensity with surprising readiness. The metal bar (of cast steel, mild steel, or brass) is clamped at its centre, and one plane end is placed close to the plane surface of a massive block of metal. This block and the bar are connected one to each side of the condenser of the valve maintained circuit,

a polarising battery being inserted in one of these leads. Tuning is carried out at first by comparing the note emitted by the bar when struck endwise with that heard in the ear-piece of a reed telephone, to which no leads need be attached, since the stray magnetic field from the induction coil in the valve set makes it give out a note of the frequency of the set. The final tuning may be made in this way by beats, or by beats between the forced oscillations of the bar and its natural oscillations evoked by impact.

A bar of the same material of half the length will vibrate without the polarising battery if the condenser

m the maintaining valve set be cut down to a quarter of its former capacity. The fine tuning in this case is by beats between the natural note of the bar and a faint note emitted by the induction coil of the set. This note is due to the unpolarised vibration of the structure of the coil set up by the main oscillating current. Rods and tubes of electrically non-conducting material could doubtless be caused to oscillate in both these ways, that is, by polarised or unpolarised electromagnetic forces, by winding them suitably with conductors. Non-conducting rods could also be used for the electric attraction method after rendering one end conducting and providing a conducting path from this end to the clamp by plating or otherwise. The advantages of fused quartz for such work are patent.

Magneto-striction is a unidirectional effect in nickel. In iron and steel the effect is less, and in some circumstances does not increase with increase in field. There ap-

peared then the possibility that attempts to maintain oscillations by magneto-strictive forces might fail with iron and its varieties, but suc-ceed with nickel. Troubles threatened to arise in consequence of eddy currents and hysteresis. However, it turned out on trial that east steel bars and mild steel bars could be maintained in resonant vibration with very great facility. With nickel the effects are even more striking. Both polarised and unpolarised electrostrictive forces may be employed. In the polarised case a coil carrying a constant current surrounds the middle of the bar, and the oscillating current from a valve set is sent round a coil conveniently wound on the same former. obtain the unpolarised effect, care should be taken that the bar is not magnetised to begin with. If it is magnetised one can very readily obtain the polarised effect; the permanent magnetic state of the bar then performs the function of the direct current. If the induction coil of a 'tuned anode' assemblage with grid coul coupling be itself used to provide the alternating field, then it is convenient to provide a separate winding for the direct current. In this case a galvanometer in the grid coil will indicate the presence of the oscillating bar.

The variations in the deflexions of the grid galvanometer are similar to those in which the set is influenced by a neighbouring resonating circuit, a result in accord with the masterly researches of Butterworth (Proc. Phys. Soc., vol. 27, p. 410). On increasing the capacity very slowly, as resonance is approached, the deflexion falls until a value of the capacity is reached marked by a sudden drop in the current; this fall is immediately followed by a sudden rise to less than the previous value. On reversing the changes in capacity the deflexion decreases and then suddenly rises at a value of the capacity differing slightly from that at which the drop occurred as the capacity was increased. The exact point of resonance lies

between these two values. This method of tuning a valve set to the resonant frequency of a neighbourmg circuit is a modification of Austin's well-known 'double click' method. Both methods are described in Moullin's "Radio Frequency Measurements," pp. 14 and 136. In an experiment on a nickel rod a metre long and 2.54 cm. diameter, the critical points on the condenser scale were separated by an interval of a four thousandth part of the whole capacity. On clamping the bar by means of heavy lead weights these irregularities disappear. Clamping the bar corresponds to breaking the connexions in the neighbouring circuit.

Such experiments need not be confined to bars of one material, nickel or iron could be suitably attached to bars of other materials. Nor need the oscillations be wholly longitudinal, for example, a conventionally shaped tuning fork could be thrown into resonant vibration by subjecting the junction of the prongs to a vibrating magnetic field in the plane of the fork and at right angles to the prongs.

The field producing magneto-striction may be due to a current carried by the magneto-strictive body. Thus when a current traverses a wire of nickel its circumference shrinks and the whole wire will therefore tend to increase in length. Thus Beatson heard a sound produced by an intermittent current flowing in an iron or steel wire (Beatson, Elect. Mag, April 1846). This reference is taken from a remarkably interesting paper by Honda and Shimizu (Phil. Mag., vol. 4, Series Six, p. 645) entitled "Note on the Vibration of Ferromagnetic Wires placed in a Varying Magnetizing Field," and published twenty-five years ago. In their paper the earlier work is reviewed and an account is also given of their own experiments on the subject carried out with such resources as were then available for experimenters. Magneto-strictive oscillations are so readily produced that it may well transpire that materials which when tested by static methods do not exhibit the effect will, when subjected to properly tuned fields, be found to possess it. For example, some variety of invar may be sufficiently magneto-strictive to oscillate in a tuned field; so that in addition to obvious important technical applications such as the provision of sources of oscillations and frequency standards, this method may be of scientific value.

A paper on some parts of this very wide and fascinating subject is in preparation.

J. H. VINCENT.

L.C.C. Technical Institute, Paddington, London, Nov. 30.

#### Standardisation of Telephone Apparatus.

In the article on my paper on telephone apparatus standardisation in NATURE of Nov. 26, the writer states that it is not easy to understand what telephone engineers mean by a transmission unit, and I agree that if reference only is made to the short statement included in my paper this is certainly true. I may, perhaps, therefore be allowed to supplement this statement by the following remarks:

Until recently the telephone engineer expressed losses and gains in transmission efficiency in two ways, namely: (1) in terms of the product of attenuation constant and length,  $\beta l$ ; (2) in terms of a standard

cable having certain definite line constants.

The objection to (1) is that it is strictly applicable only to a homogeneous telephone line of infinite length, and that such lines do not occur in telephone practice, and that, furthermore, the product of attenuation and length is meaningless when applied to a piece of telephone apparatus.

The objection to (2) is that it is arbitrary, and is dependent on the frequency transmitted.

eta l, however, is equivalent to  $\log_s \frac{\imath_1}{\overline{\iota}_2}$  or  $\log_s \frac{v_1}{v_2}$  or  $\log_s \frac{p_1}{p_2}$ , where  $i_1, \imath_2, v_1, v_2$  and  $p_1, p_2$  are input and output currents, voltages, or powers respectively.

In this form the conception of a product of attenuation and length has disappeared, and hence the application to non-homogeneous and short lines and to apparatus generally is logical So far this is the argument for the use of the unit termed the 'néper,'

which is equivalent to  $\frac{1}{2}\log_e\frac{p_1}{p_2}=1$ . The advocates of the unit termed the 'bel,' that is,  $\log_{10} \frac{p_1}{p_2} = 1$ , claim that in this form the relationship between the numerical values of the units and the actual input and output power ratios is much simpler to memorise and more convenient for use by working telephone engineers than when natural logarithmic values of ratios are used, and that as the infinite homogeneous line, on which the unit  $\beta l$  is based, is an abstract conception, there is no advantage in retaining this conception in the form of the natural logarithm of a ratio

In conclusion, it may also be pointed out that transmission values based on the direct ratios of input and output powers could be used to express transmission efficiency, if it were not for the large range of numerical values required, and the fact that a number of individual transmission values would require multiplying together to obtain the overall value, instead of adding as in the case of the logarithms of the ratios

The controversy between the protagonists of the two different systems formed the subject of a number of articles appearing in the Electrician and elsewhere B. S. COHEN. some time ago.

I HAVE read with great interest Mr. Cohen's letter, but regret that I still have only the haziest notions of what the various kinds of transmission units are, about which there is so much controversy. I thought at first they were the 'telephone traffic units,' but as these depend on the calls in a specified period of time (see B.E.S.A. glossary No. 9932) it could not refer to them. Mathematical engineers like Dr. Fleming call  $\beta$  the wave-length constant and  $\alpha$  the attenuation constant. Apparently a distortionless circuit is considered. I assume that a 'homogeneous' circuit is the same as what Heaviside called a distortionless circuit. Until clear, mathematical defini-tions of the 'transmission units' are given, it seems a waste of time to discuss them at international or other meetings.

THE WRITER OF THE ARTICLE.

# John W. Draper's Position in Science.

IN NATURE of Sept. 24 the interesting Calendar of Discovery and Invention states that the first astronomical photographs were made in 1840 by John W. Draper, using daguerreotype plates; also that Draper's last great photographic achievement was a record of the nebula in Orion, made on Sept. 30, 1880, and that attempts at improving on this first effort were cut short by Draper's death. Here, at New York University, where Draper was a member of the faculty during the productive years of his life, we were gratified to see this appreciative note about him. In the interest of accuracy, however, it should be stated that the photographs of the great nebula in Orion were

obtained by Draper's son, Henry, who was in his own right the leader of stellar photography in America The photograph made on Sept 30, 1880, was given 57 minutes of exposure. In March 1881 a better photograph was made by Henry Draper from an exposure of 104 minutes, and on Mar. 14, 1882 (more than two months after the death of John W. Draper), a remarkably successful exposure of 137 mmutes was made, which showed stars of the 147 magnitude of Pogson's scale—stars invisible to the eye. Henry Draper also obtained many excellent photographs of the spectrum of the nebula in Orion Unfortunately, Henry Draper died suddenly on Nov 20 of the same year at the age of forty five.

The reference in the Calendar to the first astronomical photograph undoubtedly means the daguerreotype of the moon made by John W. Draper in 1840 after an exposure of 20 minutes—a representation about an inch in diameter. Daguerre had attempted the feat but without success. John W. Draper experimented in photographing the solar diffraction spectrum on paper before the daguerreotype process was invented, but he did not know how to develop and fix his image, until Daguerre, Talbot, and Herschel worked out their developing and fixing processes. Herschel made the first useful photograph of the solar spectrum in 1840;

Draper did not succeed in this until 1842.

For some time I have been anxious to learn the true evaluation of John W. Draper's place in science. He was a man of such varied interests and was au courant with so many scientific developments that it is difficult to gauge his status. For example, thirteen years before Kirchhoff published his celebrated memoir on the relations between the coefficient of emission and absorption of bodies for light and heat, Draper had arrived at some of these same facts non-mathematically. There is no doubt that Draper contributed importantly to the advancement of knowledge of radiant energy. Just how much credit is due to him for his varied researches is the question

P. B McDonald.

New York University, Nov. 30.

# A Theory of the Upper Atmosphere and Meteors.

There seems to be a factor omitted by Mr. Maris in the second paragraph of his letter in NATURE (Dec. 10, p. 839) which may modify somewhat the figures he gives. If the constituents of the atmosphere were uniformly mixed at all altitudes and then left free from convection currents, there would be a partial separation into lighter and heavier particles undoubtedly, but the level reached by the diffusing

gases would be conditioned by three factors.

These will be realised readily if we remember that the earth is, in fact, a huge centrifuge and (neglecting convection currents, together with the steady flow into space of some of the lightest particles) the equilibrium position of any constituent depends on (1) gravity, (2) centrifugal force (if I may be pardoned for using such an old-fashioned expression), and (3) osmotic pressure. (2) is small compared to (1), and our centrifuge is therefore one in which the heavier particles converge inwards, but this movement is arrested by (3) just as in an ordinary centrifuge. Unfortunately, so far as I am aware, the osmotic pressure of a mixture of gases has not been determined; I would, however, suggest that if the 'optical centrifuge' described by me (NATURE, Dec. 10, p. 840) were charged with a mixture of argon and hydrogen, some light might be thrown on the subject.

BERKELEY.

Berkeley Castle, Gloucestershire.

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#### Further Hominid Remains of Lower Quaternary Age from the Chou Kou Tien Deposit.

Ar a meeting of the Geological Society of China. held on Dec 2, 1927, announcement was made of the discovery of a lower molar hominid tooth in the cave deposit at Chou Kou Tien, near Peking. The new specimen was obtained close to the site from which the first hominid teeth from this locality were recovered and in the same stratum of the deposit (NATURE, Nov. 20, 1926, p. 733) This deposit, which at first was thought to be Upper Phocene, is now known to be basal Lower Quaternary in age (very early Pleistocene) The find was made on Oct. 16 by Dr Birger Bohlin, paleontologist attached to the Geological Survey of China. Mr. C. Li, geologist from the Survey, and Dr. Bohlin have been in charge of the extensive excavations on this important site, which have been carried on during the past season by the Geological Survey in co-operation with the Department of Anatomy of the Peking Union Medical College

The tooth is a relatively unworn and perfectly preserved lower permanent molar, having incompletely formed root tips, and evidently from an individual in the stage of development represented by that of an eight year old modern European child. The general morphology of this specimen leaves no room for doubt as to its hominid status, and it evidently was derived from the same jaw as that from which came the lower premolar tooth discovered last year by Dr. O. Zdansky. A full description of the latter specimen and of the associated worn upper molar has been published this year by Dr. Zdansky (Bull. Geol. Soc. China, vol. 5, No. 3).

Evidence of a convincing nature points to a close mutual relationship between the two individuals, adult and immature, represented by the teeth recovered from the Chou Kou Tien deposit. The newly discovered specimen displays in the details of its morphology a number of interesting and unique characters, sufficient, it is believed, to justify the proposal of a new hominid genus Sinanthropus, to be represented by this material. A complete and fully illustrated report on this new specimen is now in press, and will be published early in December in Series D, Palæontologia Sinica, vol. 7, Fasc. 1.

DAVIDSON BLACK.

Department of Anatomy, Peking Union Medical College, Peking, China, Nov. 24.

### The Publications of the Royal Society.

It would be a pity if—as, of course, cannot be intended—the remarks in the leading article of Dec. 17 were taken, among an uninstructed public, to imply some disparagement of the scientific quality of the output of the Cavendish Laboratory in proportion to its extent. In the present avalanche of theories of atomic processes and radiation, what appears to be necessary more than ever is precise and informed experiment in this complex and elusive domain. Where are we likely to secure these ideals if not in a company where all the practical experience of all the ages of radio-activity is concentrated? At any rate, it may be permitted to record the judgment of one outside student of current physical literature, that it is not there that the fault, if any, is to be located.

Joseph Larmor.

Cambridge, Dec. 19.

#### The Antirachitic Vitamin D.

WHILE the chemical nature of the six known vitamins remains obscure, recent advances in knowledge have brought us very much nearer to understanding that of one of them, namely, the antirachitic vitamin D. This has been brought about through the work of Rosenheim, Webster, Drummond, Heilbron, Hess, and Windaus, some of whom have now shown conclusively that vitamin D may be produced in a highly concentrated form from a pure crystalline substance, ergosterol, merely by acting upon it with sunlight or the radiation from a mercury-vapour lamp. This discovery is of great practical as well as scientific importance

Following the observations that the cure of infantile rickets was brought about by exposure of the body to ultra-violet light and by administration of cod-liver oil, it was found that a number of foodstuffs containing cholesterol, after exposure to ultra-violet light, were rendered effective as curative agents for rickets artificially induced in rats by previously feeding them on a diet devoid of vitamin D. From this the workers referred to were led to study cholesterol, ergosterol, fungisterol, and  $\alpha$ -,  $\beta$ and y-sitosterols. At first it appeared that each of them developed activity under the influence of ultra-violet irradiation; but later it was shown that these compounds can only be purified with some difficulty, and it was proved that cholesterol and  $\beta$ - and  $\gamma$ -sitosterol when completely purified can no longer be activated by irradiation, and there is reason for supposing that the same will be found to be true of a-sitosterol and fungisterol. On the other hand, all the evidence goes to show that ergosterol is the sole antirachitic precursor

If this be so, then ergosterol must be present in practically all fats of animal or vegetable origin, for all of these are capable of activation by irradiation, but it is found chiefly in fungi—in ergot of

rve and in yeast

When ergosterol is exposed to ultra-violet irradiation, it loses its crystalline character and becomes resinous. Oxygen does not appear necessary for this change, which can in fact best be effected in vacuo or in an atmosphere of nitrogen. The resinous substance thus formed is very highly active in curing rickets. The activity is, however, destroyed if the irradiation be long continued Irradiated ergosterol has been found to possess remarkably powerful physiological activity; indeed, Miss K. H. Coward has shown that its calcifying effect can be demonstrated with so little as 1/100,000 mgm administered to a rat in daily doses

Of the vitamins, vitamin D is the one which pre-eminently needs to be artificially added to the diet, especially in sunless climates. The reason for this will be clear when it is considered that it is chiefly formed in animals rather than in plants, and results from exposure of the animal to sunlight or to a source of ultra-violet rays. It is well known that the sebaceous glands contain sterols and sterol esters, and there is good evidence for believing that it is from this source that the animal derives its

antirachitic vitamin It has been shown, moreover, that the liver acts as a storehouse for this vitamin when produced, and that a reserve is set up in the animal during the summer months, by which it is enabled to maintain good health during the winter It has been shown, too, that, as a consequence of the impoverishment of the store, the milk of a cow contains progressively less vitamin D as the winter months proceed. Milk and butter provide the most important dietetic sources of this vitamin; and for this reason, and because of the weakness of the sun's rays in winter, human kind suffer then impoverishment in respect of vitamin D, which is neither produced by the action of the sun's rays on their skins nor supplied in their diet in adequate amount

Vitamin D appears to be necessary to the animal body for the proper control of the calcium balance, and a lack of it results in a depression of the phosphorus or calcium, or of both, in the blood. Moreover, the more cereal there is in the diet, especially oatmeal, the greater is the amount of vitamin D required. Its practical importance is by no means limited to the prevention or cure of rickets, but applies also to other conditions causing greater or less ill-health and suffering It has, for example, already been shown by the admirable work of Prof. and Mrs. E. Mellanby that dental caries may be traced to a deficiency of vitamin D. From their work it would appear that, in a growing child, bone formation makes a first call on the calcium metabolism and may rob the teeth unless sufficient or an excess of vitamin D is provided. Indeed, dentists throughout England can point to innumerable examples of dental caries traceable to the substitution of margarine for butter during the War. In childbirth the drain on the mother is well known to result in dental caries, and there is strong reason for supposing that this could be prevented by the administration of more vitamin D.

The growth of population is such that the world production of butter is becoming insufficient to provide for all an adequate ration of vitamin D. Cod-liver oil provides another source of vitamin D, but irradiated ergosterol has the great advantage of being practically without taste. Moreover, it is less expensive, and being of standard purity the amount administered can be quantitatively adjusted with great accuracy.

The practical outcome is that the manufacture of ergosterol from yeast has been set up in Great Britain, and it is being irradiated commercially under proper scientific control with animal tests. Consequently vitamin D can be provided sufficient to meet the world's requirements. English manufacturers are issuing it in pellets or capsules and in oily solution, also in combination with vitamin A and malt extract, so that it is easy for all to make good the deficiency due to climatic influences during the winter months. Thus no time has been lost in applying this discovery of science to essentially practical ends.

# Atoms and their Packing Fractions.1

By Dr. F W. Aston, F.R.S.

THE original mass-spectrograph was set up in the Cavendish Laboratory in 1919 resolving power was sufficient to separate mass lines differing by about 1 in 130, and its accuracy of measurement was about 1 in 1000 These capabilities sufficed to determine with fair certainty the isotopic constitution of more than fifty elements, and to demonstrate that. with the exception of hydrogen, the masses of all atoms could be expressed as integers on the scale O = 16 to one or two parts in one thousand. For advance in two directions of fundamental importance, namely, the resolution of the mass lines of the heavier elements and the measurement of the divergences from the whole number rule, a considerably more powerful instrument was required and has now been constructed. The increase in resolution is obtained by doubling the angles of electric and magnetic deflexion, and sharpening the lines by the use of finer slits placed farther apart. The new instrument has five times the resolving power of the old one, far more than sufficient to separate the mass lines of the heaviest element known. Its accuracy is 1 in 10,000, which is just enough to give rough first order values of the divergences from whole numbers.

Such a high order of accuracy can be attained only when lines are so near together on the mass spectrum that not only can their distance apart be determined with the highest accuracy but also the calculation of their mass difference will not be seriously affected by error in the dispersion constant. These conditions may be made use of in several different ways, as follows:

Method I.—Direct measurement on a single spectrum. This method is virtually free from all uncertainty, but can only be applied to bodies giving lines clearly resolved, but differing by less than I per cent. in mass. These cases are unfortunately very rare. The best example is the doublet given by oxygen-methane shown in spectra I. and IV. (Fig. 1). Here the lines only differ by 0.2 per cent. in mass, and can be obtained of equal intensity by manipulation of the quantities of oxygen and methane present in the discharge tube.

Method II, which may be called the method of series shift, can be employed whenever the masses to be compared form terms in a series the unit of difference of which is not too great. Two potentials are chosen which will bring consecutive terms into the desired contiguity, and these are applied to the electric plates alternately during the exposure while the magnetic field is kept constant. In this way irregularities in the series can be measured. A good example of this is shown in spectrum II. where the series 79, 80, 81, 82 given by bromine and its hydrides is tested in this way and the interval between Br79 and Br80 determined in terms of the hydrogen atom.

<sup>1</sup> From the Bakerian Lecture—A New Mass-Spectrograph and the Whole Number Rule, *Proc. Roy. Soc.* A, vol. 115, p. 487, 1927, to which the reader is referred for all details of apparatus and technique

Method III is the most generally applicable. It is the original bracketing method modified by the use of a small interval instead of a bracket the lines are brought into the required contiguity by a change in the electric field, and this change is measured by means of two other mass lines of known ratio.

In the calculation of atomic masses from the ratios measured, the atom O<sup>16</sup> is taken as the standard of mass The results so far support the conclusion that oxygen is a simple element and that therefore this scale is the same as that used in chemical atomic weights

Ever since the discovery of the whole number rule, it has been assumed that in the structure of atoms only two entities are ultimately concerned, the proton and the electron If the additive law of mass was as true when an atomic nucleus is built of protons plus electrons as when a neutral atom is built of nucleus plus electrons, or a molecule of atoms plus atoms, the divergences from the whole number rule would be too small to be significant. and, since a neutral hydrogen atom is one proton plus one electron, the masses of all atoms would be whole numbers on the scale H = 1. The measurements made with the first mass-spectrograph were sufficiently accurate to show that this was not true. The theoretical reason adduced for this failure of the additive law is that, inside the nucleus, the protons and electrons are packed so closely together that their electromagnetic fields interfere and a certain fraction of the combined mass is destroyed. whereas outside the nucleus the distances between the charges are too great for this to happen. The mass destroyed corresponds to energy released, analogous to the heat of formation of a chemical compound, the greater this is the more tightly are the component charges bound together and the more stable is the nucleus formed. It is for this reason that measurements of this loss of mass are of such fundamental importance, for by them we may learn something of the actual structure of the -nucleus, the atomic number and the mass number being only concerned with the numbers of protons and electrons employed in its formation.

The most convenient and informative expression for the divergences of an atom from the whole number rule is the actual divergence divided by its mass number. This is the mean gain or loss of mass per proton when the nuclear packing is changed from that of oxygen to that of the atom in question. It will be called the 'packing fraction' of the atom and expressed in parts per 10,000. Put in another way, if we suppose the whole numbers and the masses of the atoms to be plotted on a uniform logarithmic scale such that every decimetre equals a change of 1 per cent., then the packing fractions are the distances, expressed in millimetres, between the masses and the whole numbers.

In Table I. is given a list of elements on the isotopic constitution of which further light has been

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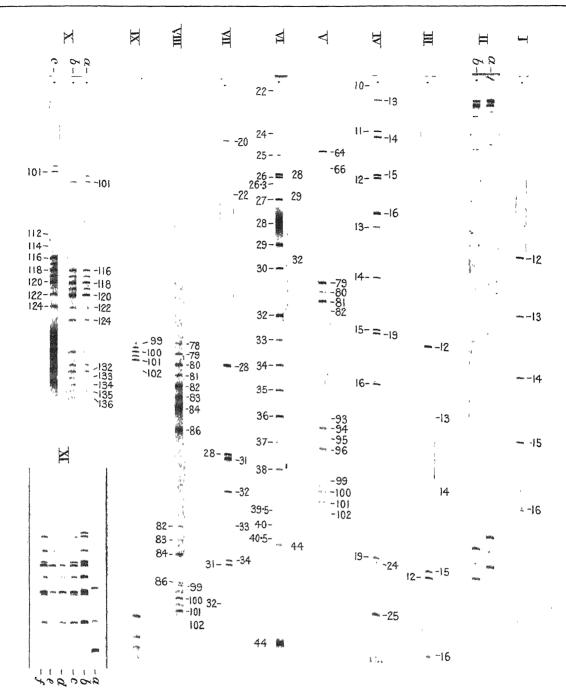


Fig. 1 -Description of the Mass-spectra reproduced

-Single spectrum of the C<sub>1</sub> group, showing oxygen methane

I —Single spectrum of the  $C_1$  group, showing oxygen methane doublet II —Double spectra illustrating comparison of Br lines by Method II III—Double spectrum comparing CH<sub>3</sub> and C, voltages 280, 352 The oxygen methane doublet is seen on the extreme right IV.—Double spectrum comparing F and  $C_3$ , voltages 280, 352 This combined with III gives the mass of fluorine in terms of carbon and hydrogen by the general Method III The line of B<sup>11</sup> can be seen and, very faintly, that of B<sup>12</sup>. The oxygen methane doublet is shown very clearly in the lower potential spectrum V—Single spectrum taken with CH<sub>1</sub>Br showing the pairs of lines due to Br, HBr, CH<sub>2</sub>Br, CH<sub>3</sub>Br, and the second order mercury group

when the state we have the second ofter mercury group

VI —Double spectrum comparing Br<sup>\$1</sup> with CO<sub>2</sub>, voltages 300, 324 The higher voltage spectrum, which had an exposure of half an hour, shows the triply-charged Br line at 26 3 It contains the lines of sulphur, chlorine, etc., and is an admirable illus-

tration of the linear distribution of lines differing by one

unit
VII —Double spectrum showing the lines of phosphorus and
its hydrides photographed between the lines of carbon monoxide

and phosphorus.

VIII —Double spectrum comparing Kr<sup>86</sup> with Hg<sup>198</sup>. The lines of krypton are seen near the middle The second order lines of mercury are shown under high dispersion.

IX —Spectrum showing the second order mercury group very clearly.

IX —Spectrum showing the second order mercury group very clearly X = (a) and (b) spectra showing the even spacing of the tin monomethide and venon lines (a) The same with long exposure showing eleven isotopes of tin XI—Six double spectra taken with the same voltages 360, 368 Each has an exposure suited to a particular pair of lines, for comparison of  $CO_2$ ,  $K_7$ , and Br (a)  $K_7^{80}$ ,  $CO_2$ , (b)  $K_7^{18}$   $K_7^{80}$  and  $K_7^{80}$   $K_7^{82}$ , (c)  $K_7^{190}$   $K_1^{82}$  and  $K_7^{81}$ , (d)  $K_7^{83}$ , (d)  $K_7^{83}$ , (d) after addition of methylene bromide  $B_1^{70}$   $B_7^{81}$ 

thrown during this research. This may be regarded as supplementary to the complete table of isotopes last published <sup>2</sup>. With this it forms a complete list

TABLE I

Element	Atomic number	Atomie weight	Minimum number of isotopes	Mass numbers of isotopes in order of intensity
S Sn	16 50	32 06 118 70	3 11	32, 33 34 120, 118 116 124, 119, 117 122, 121, 112 114,
Xe	54	130 2	9	129 132, 131, 134, 136 128, 130, 126 124
Hg Pb	80 82	200 6 207 2	6 3	202, 200, 199, 198, 201 204 208, 206, 207

of non-radioactive isotopes discovered up to the present

Table II. gives a list of the precision measurements including those calculated for lithium from Costa's results. The margin of error given may be

TABLE II.

Atom	Packing fraction × 101	Mass 0 = 16	Atom	Packing fraction × 101	Mass O =16
Xer Mer	77 8 ± 1 5 5 4 ± 1 20 0 ± 3 17 0 ± 3 13 5 ± 1 5 10 0 ± 1 · 5 30 ± 1 5 · 7 ± 2 0 0 0 · 0 + 1 0 · 2 ± 1 (2 2	pes) . pes)	Cl <sup>35</sup> A <sup>36</sup> Cl <sup>37</sup> A <sup>40</sup> As Kr <sup>78</sup> Br <sup>79</sup> Kr <sup>80</sup> Kr <sup>81</sup> Kr <sup>84</sup> Kr <sup>84</sup> Kr <sup>84</sup> Hg <sup>200</sup> Ph <sup>206</sup>	$\begin{array}{c} -48 \pm 15 \\ -66 \pm 15 \\ -66 \pm 15 \\ -50 \pm 15 \\ -72 \pm 1 \\ -88 \pm 15 \\ -94 \pm 2 \\ -90 \pm 15 \\ -91 \pm 2 \\ -86 \pm 15 \\ -88 \pm 1$	34 983 35:976 36:980 39:971 74:934 77:926 78:929 79:926 80:926 81:927 82:927 83:928 85:929 126:932 119:912 133:929 200:016 206:016

regarded as an outside limit, hence it is large in all cases where comparisons are made indirectly. The masses of the atoms are simply calculations from the packing fractions, so no particular significance is to be attached to the final digit. The agreement with chemical and other results is generally good in cases when such agreement is to be expected, but the best test of the accuracy of the measurements is their consistence among themselves. So far this is highly satisfactory, and makes it reasonably probable that most of the packing fractions are within one unit of their true value.

As has already been explained, in addition to the first two fundamental constants of an atom, atomic number and mass number, which settle the numbers of protons and electrons contained in its nucleus, we now have a third, the packing fraction, which gives entirely new information on the nucleus, for it is a measure of the forces binding those protons and electrons together The discriminating value of this information is clear at once, for example, had the packing fraction of the helium atom not

been greater than that of the oxygen atom it would have ruled out the possibility that the nucleus of the latter was simply built of four unchanged helium nuclei or alpha particles, for there would have been no loss of energy, that is, mass detect, in the latter to represent the binding forces holding the four particles together. High packing fractions indicate loseness of packing, and therefore low stability low packing fractions the reverse. We are at once led to inquire into what happens to the packing fraction as we ascend from atom to atom in the scale of mass.

The result of plotting packing fractions against mass numbers for all atoms so far investigated is indicated in Fig. 2. Fig. 3 gives the same plot for the light elements on a larger scale. These indicate that the packing fraction as a function of mass number shows simple regularities of a remarkable kind. If we ignore for the present the large gaps

which it is hoped to bridge as the work proceeds, it appears that all atoms, except those of light elements of even atomic number, approximate to a single curve. Starting at hydrogen with a large positive packing fraction, the curve drops rapidly, crosses the zero line in the region of mass number 20 and sinks to a mmimum value Very recent experiments with nickel give a provisional value - 10 for the packing fraction of its lighter isotope Ni<sup>58</sup> This is the lowest obtained, and suggests that the minimum is in the iron nickel region, which may have a significance in connexion with the presumed geological abundance of these elements. The curve then rises again and recrosses the

zero line in the region 200 There is no marked periodicity

As was to be expected, the most interesting region is that of the lightest atoms, shown in Fig. 3. In isotopic constitution and relative abundance there is a fundamental class difference between elements of odd and elements of even atomic number <sup>3</sup> This is reflected in the behaviour of their nuclei under the disintegrating impact of alpha particles, for Rutherford and Chadwick have shown that odd numbered elements have less stable nuclei and emit protons at a much higher average speed than those of even number. This difference is now shown to extend to their nuclear masses. Whereas the atoms of odd atomic number, irrespective of whether their mass number is odd or even, approximate to a smooth curve rising steeply to hydrogen, those of even atomic number lie well below and may be said to form a branch rising less steeply to helium. For comparison, the rectangular hyperbola x (y+125) = 250 has been drawn in Fig 3 Such a curve is the locus of the packing

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<sup>&</sup>lt;sup>2</sup> F. W. Aston, Phil. Mag, vol. 49, p. 1199 (1925).

<sup>&</sup>lt;sup>3</sup> See "Isotopes," 2nd edition, p. 131.

fractions atoms of mass = mass number + 1/40 unit, if  $O = 16 (1 + 12.5 \times 10^{-4})^{-1}$ 

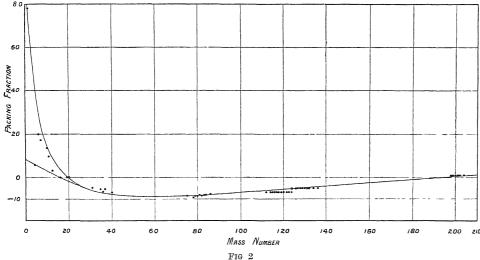
In the cases of atoms of odd atomic number the measurements show a definite approximation to this curve. This means that the masses of the nuclei of these particular atoms can be regarded as

who claim that protons can be detached from these nuclei by the impact of alpha rays. Neither do the observations of Rutherford and Chadwick that the chance of disruption of protons from lithium atoms, if possible at all, is small compared with those of boron, nitrogen, etc., show any serious discordance

with Costa's results for lithium, here plotted, for the position of these suggests that their nuclear structure, though loose, is not so loose as that of the others. It is unfortunate in this connexion that data for beryllium are not available.

The fact that the packing fractions of the heavier atoms show a smooth distribution and do not decrease continually with increase of mass number

of mass number is interesting. It is not what one would expect were the nucleus a structure similar to the outside of the atom, and possessing a periodic function. It is much more in keeping with the view put forward by Sir Ernest Rutherford 4—that the nucleus consists of an inner part of uniform, tightly bound

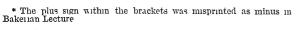


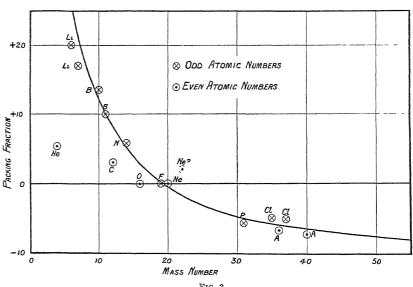
being made up of two distinct parts, one which changes by unity for each unit advance in mass number, and another, a small excess, which remains constant. To illustrate this point we may imagine the nuclei of these atoms to consist of a central core of maximum tightness of packing, correspond-

ing to a packing fraction on the oxygen scale of -125, which is surrounded by, let us say, three protons or neutrons attached with a tightness represented by a packing fraction 83 3. That is to say, these three bodies will together account for the excess 1/40 unit. The free proton has a packing fraction on the new scale of 778 + 12.5 = 90 3 which leaves a balance of 7 for binding purposes in each case.

No stress is to be laid on these figures which are purely illustrative, nor is it intended to discuss the possibilities in any detail at present, but the facts do certainly suggest that the nuclei of light atoms have a loose, and therefore heavy, external structure of lightly bound protons or neutrons common to them but not possessed by

the much more stable and tightly bound atoms of helium, carbon, and oxygen. Whether this is so or not, the position of carbon and oxygen on the diagram indicates a tightness of packing entirely in favour of the views of Rutherford and Chadwick as against those of Kirsch and Pettersson,





'crystalline' structure, outside which is a looser system of neutrons, protons, and electrons which is more complex the heavier the element. The crystalline packing supplies a minimum possible packing fraction, while the increasingly complex outer structure may be taken to explain the rise of the packing fraction in very heavy elements.

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<sup>4</sup> Guthrie Lecture of the Physical Society of London, 1927

Baron de Montyon, F.R.S. (1733-1820), and the Paris Academy of Sciences.

ANTOINE JEAN ROBERT BAPTISTE AUGET, Baron de Montyon, economist and philanthropist, was born at Paris on Dec 23, 1733, and he died there on Dec 29, 1820, at the is held in honoured remembrance for his public work and enlightened beneficence. Whilst domiciled in England-for reasons which are given below—de Montyon was, on Nov. 5, 1812, elected into the Royal Society of London Soon after, he signed the charter book and was formally admitted

Trained in France for the law, Montyon held various important provincial and State appointments, exhibiting marked independence of thought and freedom from bias, associated with an integrity certainly none too prominent amongst some of his

contemporaries.

Prior to the period of revolutionary turmoil, M. de Montyon ĥad made anonymous and handsome donations to the Paris Academy of Sciences, the French Academy, and the Academy of Medicine. These became null and void in the political upheaval. They were, however, restored before his death.

De Montyon, rich by inheritance, and disinclined to parley with any new regime, emigrated in 1792, settling for a time at Geneva, afterwards transferring to London. He did not return to Paris until 1815, being then eighty-two years old. Count Rumford had died in the previous year; Davy was then thirty-seven years old The English journals of the period of de Montyon's residence in London are provokingly silent, although two works by him had been published there. Space will not permit of quoting their lengthy titles.

Appended is a copy of de Montyon's certificate

of qualifications for the Royal Society:-

"Anthony J. B. R. Auget de Montyon, Baron de Montyon, Counsellor of State in the late Royal Government of France, and now residing at No. 38 Brewer Street, Golden Square; a gentleman of eminent acquirements in political economy and various branches of Natural Knowledge, being desirous of becoming a fellow of the Royal Society, We the underwritten do on our personal acquaintance with him, recommend him as worthy of the honor he solicits, and likely to become a valuable Member. C. Blagden, John Symmons, J. Planta, Samuel Foart Simmons, Wm. Tooke, J. Guillemard, John Sinclair, Gilbert Blane, Geo. Thos. Staunton, Geo. Pearson.'

It is not a little curious that de Montyon seems never—either before or after his election—to have dined at the Royal Society Club, especially when one calls to mind that Sir Joseph Banks was president of the Society at the time, and frequently introduced foreigners of distinction. M. Coquebert de Montbret, a compatriot, was among these, and he dined, so Sir Archibald Geikie has told us, on four occasions after 1809. Here it may be interpolated that de Montbret was, with Laplace and Fourier, on a commission for the institution of the Montyon prize in statistics (1817). Doubtless sufficient reason is found in the quietness of Montyon's life, necessitated by the circumstances

of exile. Moreover, he had never sought the fashionable world, preferring the society of men of It is recorded that he was a good conversationalist, and prolific in attractive reminiscences. Whilst in England he disbursed large sums of money in support of companions in exile, and also amongst the French prisoners of war. His portrait shows an aspect of restful dignity, singu-

larly resembling that of Newton.

At Montyon's obseques strict simplicity was His own wishes in this respect were "Je veux être enterré avec la plus observed grande simplicité, ce qui doit être exécuté d'autant plus exactement que ce qui sera économisé sur cet article tourne à l'avantage de mes legs." Notwithstanding, hundreds of folk of the humbler classes attended in token of regard. The French Academy nominated one of its members to deliver a eulogy. In the twilight of his age Montyon had recalled words that he used to the King in 1796: "Ma vie n'a pas eu un grand éclat. mes actions qui ont eu une publicité indispensable prouvent que je n'ai point l'âme servile."

The prizes which are in the gift of the Academy of Sciences are enumerated below; and some notes added indicate slight variations which have followed

their institution.

(1) PRIX MONTYON DE STATISTIQUE —At a meeting of the Academy in September 1817, Laplace informed his colleagues of an anonymous offer of a capital sum of 7000 francs for the establishment of an annual prize for statistical researches. Acceptance followed, and Laplace, Montbret, and Fourier were among the members of a commission charged to prepare a scheme of management. The first allocation was made in 1819 In the year 1910, on the motion of M. Gaston Darboux, a sum of 1000 francs was decided on as the primary gift, with two commendatory awards of 500 francs. Further, an original limitation that the research should refer only to France and her colonies, is no longer enforced.

(2) Prix Montyon de Physiologie expéri-MENTALE -In June 1818 the Academy received another offer, in similar circumstances, for the foundation of a yearly prize in experimental physiology. Berthollet, Hallé, and others drew up a scheme. Later, the donor supplemented the gift. As a rule there are two awards of 750 francs each. We notice here and there in the list of awards the names of Englishmen, for example: Dr. A. D. Waller (1887) and Dr. A. B. Griffiths (1893).

(3) PRIX MONTYON DE MÉCANIQUE —In August 1819, Laplace presented a note designating this annual prize, and from the same source. The attribution is now 750 francs. In exact terms the gift is for . . . "instruments utiles aux progrès de l'agriculture, des arts mécaniques et des sciences

pratiques et spéculatives."

(4) PRIX MONTYON DE MÉDECINE ET CHIRURGIE ET PRIX MONTYON DES ARTS INSALUBRES.—This conjoint prize was dedicated by the terms of Baron Montyon's will, under date Nov. 12, 1819. There were other and large benefactions, which, however, are outside the scope of this notice—The first prize was given in 1825—A commission had formulated regulations, and amongst the members were Cuvier, Fourier, and Berthollet. The terms of the award are of wide application, whilst the prizes are open

to persons of all nationalities — In the first section are three yearly gifts of 2500 francs, and three mentions honorables of 1500 francs — In the second section (in effect, chemistry) there is a prize of 2500 francs, with a second of 1500 francs for meritorious entry. — T. E. James.

#### News and Views.

FOR several years Dr. Wilhelm Freudenberg has collected fossils from the sand-pits in the Pleistocene river deposits near Heidelberg, from which the lower law of Homo heidelbergensis was obtained. We now learn, from a communication which he has made to Sir Arthur Smith Woodward, that among the mammalian remains which he has discovered there are no less than eighteen fragments of fossil man and apes. The tibia ascribed to Heidelberg man is short and very stout, with an inward twist, and in many ways like that of a big gorilla. A fragment of a femur is also very gorilla-like. The second metatarsal is curved as in a chimpanzee, and the first metacarpal is twice as large as that of a modern man. These remains are associated with Elephas antiquus. Other fragments found not with this elephant, but with E. trogontherm, belong to a Primate about as large as an orang. There is a sagittal crest on the parietal bone, and a piece of lower jaw resembles that of Sivapithecus rather than Dryopithecus pelvis shows several features of that of a chimpanzee, and the femur and tibia are slender. Other fragments of the same age belong to two smaller Primates related to the gibbons. They seem to have had comparatively small canine teeth. In association with them, one long and remarkably human femur, an apparently human pubis, and a human navicular bone, are considered by Dr. Freudenberg to belong to a forerunner of Neanderthal man. In the upper beds, with Rhinoceros etruscus, were also found implements of quartzite, charcoal, and burnt fragments of bone.

PALÆONTOLOGISTS and anthropologists will await with great interest Dr. Freudenberg's detailed description of his finds. Remains of monkeys of Pleistocene age are known from Norfolk, the Thames valley, France, and Germany, but no trace of the man-like apes has hitherto been discovered in Europe of later date than the Lower Pliocene. If Dr. Freudenberg's results are confirmed, the search for the earliest ancestors of man in Europe is not so hopeless as it is commonly supposed to be.

The retirement is announced in the *Lancet* of Dr. A. B. Macallum, professor of biochemistry in McGill University, Montreal, and formerly administrative chairman of the Honorary Advisory Council for Scientific and Industrial Research, Canada Prof. Macallum, who was successively lecturer and professor in physiology and later professor of biochemistry in the University of Toronto, introduced a full experimental course in physiology at Toronto so long ago as 1886; at that time, no similar course for students was anywhere in existence. His research work at first

was devoted particularly to the origin of hamoglobin from the chromatin of hæmatoblasts This led to a demonstration that chromatin is an iron-holding compound and that hæmoglobin is, as it were, a degeneration product of chromatin. Later, Prof. Macallum investigated the absorption of iron compounds in the intestines, the composition of the blood plasma of invertebrates and vertebrates, and the microchemical detection of potassium, chlorine, phosphorus, calcium, iron, and copper. His latest work has dealt with the effects of surface tension on the distribution of salts in living matter. Macallum was elected a fellow of the Royal Society m 1906, in 1920 he left Toronto to take the chair of biochemistry at McGill University. He will be succeeded by Prof. J. B. Collip, whose name will be remembered in connexion with the discovery of ınsulın.

The honorary secretary of the Institution of Professional Civil Servants writes to inform us that the leading article on "The Technical Expert in the Civil Service," published in our issue of Dec. 10, has been welcomed by the professional group of civil servants. He directs attention also to the fact that, since its foundation in January 1919, the Institution has worked energetically for "a thorough reform in matters affecting the status of the technical expert," and has met with some success over a limited area in bringing conditions of employment of similar professional staffs in different departments to a uniform basis Further, by recourse to the arbitration machinery set up for the Civil Service in 1925, it has succeeded over a rather wide area, but in many cases, in obtaining piecemeal improvements in salary scales. He also points out that the reform of the non-technical branches of the Civil Service was only carried through after a series of Royal Commissions, and states that, although the Council of the Institution has loyally worked the system of Whitley Councils recently created, it is convinced that the reforms which are urgently required in the technical branches will not be achieved without an authoritative public inquiry. We entirely concur in this view, and, indeed, in the leading article on "The Expert in the Civil Service" published in Nature of Aug. 27 last, urged that a Royal Commission should be appointed to examine into and report on the present position of professional workers in the State service. We are of opinion that the need for modifications of the present Civil Service system is of pressing importance, and that in the interest of both efficiency and economy no time should be lost in providing for a comprehensive inquiry of the nature indicated.

SPEAKING at Sexev's School, Bruton, Somerset, on Speech Day, Prot John Read, professor of chemistry at the University of St. Andrews, directed the attention of the boys of his old school to some of the qualities which scientific training educed. honesty, perseverance, precision, the co-ordination of hand, eye, and brain, the development of logical methods, and the recognition of the importance of small things. Whilst confessing his enthusiasm for literary pursuits, he urged them not to be misled by references to the 'dry bones' of science, or to imagine that the man of science is less human or humane than his brethren, there is need to emphasise this in an age when no man can claim to be truly educated unless he possesses a knowledge of the general principles of physical science and comprehends how a plant grows and how an animal lives. Discussing the everexpanding part which science is playing in the industrial and economic development of the British Empire, Prof. Read referred to the activities of Imperial Chemical Industries, Ltd, and particularly to its progress in rendering Great Britain less dependent on imported liquid fuels and fixed nitrogen, and to its assistance in the development of agricul-Prof. Read also addressed the school literary and debating society on the contribution of organic chemistry to the progress of civilisation, the title of his lecture being "An Organic Chemist looks at the World"; he referred on this occasion to the nonpermanence of coal and oil as sources of energy and to their possible replacement by alcohol, which can be produced in unlimited quantity so long as the sun shines and plants grow. Mention was also made of the low-temperature distillation of coal, and of the value of brown coal as a source of energy

Ar a meeting held at the Imperial College of Science in February last, it was agreed to form a society for the purpose of studying bibliographical methods and securing unity of bibliographical procedure and classification. The first meeting of the Society was held at the Science Library, South Kensuigton, on Dec. 13, thirteen members being present. The objects of the Society were defined as follows: "To promote the study of bibliographical methods and of the classification of information, to secure international unity of bibliographical procedure and classification, and to foster the formation of comprehensive and specialist bibliographies of recorded information." The name adopted for the Society was "The British Society for International Bibliography." As the Society has been adopted as the British Section of the Institut International de Bibliographie, it is proposed to use the sub-title "British Section of the I.I.B." if necessary. Prof. Alan Pollard, of the Imperial College, was appointed president, with Dr. S. C. Bradford, of the Science Library, as vice-president, and Dr. Walter Clark, also of the Science Library, as honorary secretary. The other members of the council are Miss Snelus, Messrs. P. K. Turner, A. Esdaile, and T. Smith. At the VI<sup>o</sup> Conférence Bibliographique Internationale, held in Brussels in July last, it was agreed to confer the presidency of the Institut International de Biblio-

graphic upon Great Britain for the year 1927–28, and the British Society for International Bibliography was invited to nominate the president. It has proposed the name of Prof Pollard. The Society is prepared to receive all criticisms and suggestions for the development of the Classification Décimale of the Institut International de Bibliographie, and to transmit recommendations to the Institute. All particulars concerning the Society, the Institut International de Bibliographie, and the Classification Décimale may be obtained from Dr Clark, hon, secretary of the Society

A MACHINE which is capable of turning out one million pint bottles a week, and requires only one man to superintend its operation, is surely a remarkable achievement. Such is the machine recently constructed by the Metropolitan-Vickers Electrical Co., Ltd., at its works in Manchester (Fig. 1). The glass is melted in pots or in a tank furnace and the machine is run on rails to the mouth of the furnace A small 15-h p. electric motor is started and bottles are automatically turned out in dual moulds at the above rate. The machine consists of fifteen identical

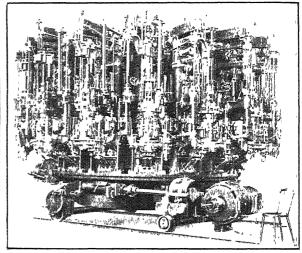


Fig 1

units which rotate around a central pillar. In the event of a breakdown of any one unit, it can be replaced in less than thirty minutes. As each unit passes the mouth of the furnace, huge arms are lowered into the molten glass, a quantity of which is picked up in a mould by means of suction. A small quantity of compressed air is then admitted to form a cavity in the neck of the bottle. Further rotation of the machine, which has a speed of six revolutions per minute, enables the glass blank thus formed to be transferred to a second mould, the interior of which is of the shape of the finished bottle. A further supply of compressed air blows the bottle to the shape of the mould. The machine moves on to the next stage, when the moulds are lowered and the bottles are automatically discharged on to a conveyor. In addition to the manufacture of bottles, this machine is equally useful for the manufacture of electric lamps

or other articles of a similar nature and is entirely a British production. It is a great improvement over previous machines, most of which are of foreign manufacture. For a complete illustrated description of the machine, reference should be made to the *Engineer* of July 1 and 8, 1927.

Mr. L. J Kettle, the electrical engineer to the Dublin Corporation, gave an interesting address to the Irish local centre of the Institution of Electrical Engineers on Oct. 13. He pointed out that the Electricity (Supply) Act, 1927, of the Irish Free State gives practically unlimited power to the Irish Electricity Supply Board. One of its duties is to investigate the natural power resources of the Free State. Towards the end of the War, some work in this direction was done by the British Government. Mr Kettle regards peat as the greatest potential power asset. Six million tons of air-dried peat are at present dug out and used per annum in Ireland. The fuel equivalent of this peat is equal to that of the whole of the coal imported per annum into the Free State. With a little State assistance and encouragement the output could be materially increased. Even if the increase were only ten per cent., it would be equivalent to all the power to be obtained initially from the River Shannon. Mr. Kettle is strongly of opinion that a comprehensive water-power survey of Ireland should be made as soon as possible. It is quite conceivable that the by-products of a peat power station would more than cover all the costs of production, and thus the electric power generated would cost nothing He urged that the Electricity Board should completely equip the model farm near Dublin with all manner of electric labour-saving devices. It would be a valuable demonstration and training centre for the propagandists who are anxious to see the whole country electrified. He pointed out that the actual production costs are now of secondary importance, owing to the large number of middlemen interposed between the manufacturer and the consumer. His cure for this state of affairs is to return to the old village industry system. He considers that a return to this system may be teasible in Treland.

Mr. C. C. Paterson, Director of the Research Laboratories of the General Electric Co., Ltd., gave an interesting address to the London Section of the Institute of Metals on Nov. 10. He pointed out that the cost of conducting materials is one of the heaviest items of expenditure in the electrical industry. For long-distance power transmission it is nearly half the total cost. In addition, it is now becoming common practice to use tubular conductors in order to prevent the formation of the corona. This adds to the expense. It is not beyond the bounds of possibility that metallurgical research will yield a high conductivity alloy which will replace copper. The possibilities of the lighter metals like bervllium and aluminium when alloyed have not vet been fully investigated. So far as the magnetic qualities of metals are concerned, it looks as if the manufacturing departments lag behind laboratory research, at least

so far as heat treatment and new methods are concerned. Practical men now recognise the great importance of the presence of gases in metals like nickel and tungsten which are used in the manufacture of electric lamps. Commercially pure metals from the factory are quite unsuitable for lamp manufacture. A two-hour treatment in 'a vacuum' is necessary until the pressure falls to 0004 mm. of mercury. It would be a great boon to the electrical industry if the metallurgist could produce an alloy in the form of wire which would keep its homogeneous nature, and retain its qualities however long it was subjected to the action of heat In other words, it must remain stable and not develop local hot spots when heated by an electric current It is of great importance to devise tests on the effects of heating on various alloys so as to enable the purchaser to get the most economical material. At the Research Laboratories of the General Electric Co., Ltd., at Wembley, experiments are being carried out on various test methods.

It is announced that Sir Ernest Rutherford has been elected a foreign associate of the Paris Academy of Sciences. The foreign associates of the Academy are limited in number to twelve, and include Sir Ray Lankester, elected in 1910, and Sir J. J. Thomson, elected in 1919.

THE Catherine Wolfe Bruce gold medal of the Astronomical Society of the Pacific, given annually for "distinguished services to astronomy" upon the nominations made by six of the world's great observatories, has been awarded for 1928 to Dr. W. S. Adams, Director of the Mount Wilson Observatory. The formal presentation will be made in the early part of next year. Provious recipients have included Prof. E. W. Brown, M. Henri A. Deslandres, Sir Frank W. Dyson, M. E. B. Baillaud, Prof. A. S. Eddington, and Prof. H. H. Turner.

At a special general meeting of the Institute of Physics, held on Dec. 16, and on the recommendation of the Board, the Royal Meteorological Society was admitted a participating society of the Institute. The Royal Meteorological Society is the sixth society to co-operate in the scheme of participation, and an important step is thus taken towards the realisation of one of the principal objects of the Institute, as expressed at its foundation, namely, to co-ordinate the work of all existing societies concerned with the science of physics and its applications.

COL CHARLES LINDBERGH has been awarded the Langley Medal for Aerodromics of the Smithsonian Institution of Washington, "in recognition of his daring non-stop flight from New York to Paris on May 20 and 21, 1927." Established in 1909 in honour of Samuel Pierpont Langley, third secretary of the Smithsonian Institution, who was the first man in the world to make a large model heavier-than-air machine fly successfully under its own power, the medal has been awarded hitherto to four men: Wilbur and Orville Wright, Glenn H. Curtiss, and

Gustave Eiffel. Col Lindbergh stated that it has been decided to offer his machine, Spirit of St. Louis, to the Smithsonian Institution to be added to the collection of aeroplanes of historic interest that it possesses

The annual report of the Rockefeller Foundation for 1926 has recently been issued. During that year the Foundation expended 9,741,474 dollars on inedical research and the prevention of disease in all parts of the world. The activities of the Foundation are reviewed by the president, Dr George E Vincent, in this report, which is illustrated with relevant maps, charts, and photographs.

In connexion with the work of the Colorimetry Section of the U.S. Bureau of Standards and the report of the Colorimetry Committee of the Optical Society of America, Mr. Irwin G. Priest is desirous of compiling a bibliography of papers and books having a direct bearing on colorimetry, spectrophotometry, and colour specifications—It is expected that this bibliography will ultimately be published in the Journal of the Optical Society. He will be glad if authors who have contributed to this subject will send him check lists of their papers, giving titles and complete journal references. Reprints will also be of service and will be gratefully received—Mr. Priest's address is Bureau of Standards, Washington, D.C

MESSRS Gurney and Jackson will publish shortly "A Popular Handbook of Indian Birds," by H. Whistler, illustrated by many coloured and black-and-white plates and text figures by H. Gronvold

THE latest catalogue (No 503) of Messrs. Francis Edwards, Ltd., 83 High Street, Marylebone, W.1, although mainly of a general character, contains sections devoted to geography and travel, botany and gardening, entomology, folklore, and natural history. It should therefore be of interest to readers of NATURE.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned .—An assistant lecturer in agricultural chemistry at the East Anghan Institute of Agriculture, Chelmsford—The Clerk of the Essex County Council, Shire Hall, Chelmsford (Jan. 9). A science master for physics and chemistry at the Longton High School-The Director of Education, Town Hall, Hanley, Stoke-on-Trent (Jan 21). A reader in chemistry at Bedford College for Women—The Academic Registrar, University of London, South Kensington, S.W.7 (Feb. 17). rubber technologist to take charge of the rubber section of a government laboratory-The Commandant, Experimental Station, Porton, Wilts. lecturer in biology at the Saffron Walden Training College for Women Teachers—The Principal, Training College for Women Teachers, Saffron Walden.

#### Our Astronomical Column.

The Spectrum of the Comet Pons-Winnecke—Two papers on this subject have recently appeared. Dr. G. Shajn (Mon. Not. Roy Ast. Soc., Supp.) gives diagrams showing the changes in the relative strength of different bands. At the end of May the band at λ388 was the brightest, those at λ405 and λ469 being in order of lessening brightness. The first band remained stationary for a week and then got decidedly fainter; while the other two brightened, that at λ469 being the brightest at the end of June. The continuous spectrum was not visible at the end of May, but gradually grew in strength after this. There was more increase of light visually than photographically, implying a change of colour from blue to yellow.

Lowell Obs. Bull. No. 86 contains a discussion by V. M. Slipher of spectrograms obtained on June 20 and 23. The continuous spectrum was then strong and showed the solar absorption lines, indicating that the nucleus was shining by reflected sunlight. The Swan spectrum was weak; there were strong cyanogen bands at λ3883 and λ4216, but the strongest bands were an unidentified series between λ3993 and λ4075. The spray of light towards the sun was the most

emissive region.

This paper, like that of M. Baldet recently noticed in this column, directs attention to the remarkably small size of the stellar nucleus. The estimate at the Lowell Observatory gave a linear diameter of two or three miles, that of M. Baldet being less than a mile.

Measures of Double Stars.—Prof G. van Biesbroeck, in addition to his cometary work, undertakes a large amount of double-star observation with the 40-inch refractor at Yerkes Observatory. Vol 5, part 1, of its *Publications* contains his measures of some 3000 stars, the majority of which are stars the duplicity of which was discovered by Prof. Hussey

about the beginning of the century. The old and new measures are compared, and wherever sensible change appears an estimate is made of the hypothetical parallax, both on the assumption of a uniform mass double that of the sun, and also from the Eddington curve connecting mass with absolute magnitude. He also discusses the errors of published orbits and deduces many new ones.

One of the stars is the long-period variable X Ophruchi, which has an unchanging 8 9 mag. companion at a distance of  $\frac{1}{4}$ ". Its hypothetical parallax is 0".007, in good agreement with Adams's spectroscopic value 0" 005 from the unchanging component, the type of which is K0. It is noted that the trigonometrical measures published by van Maanen and Gringrich are probably affected by the apparent shift of the combined star-image due to the change in light. There is a new orbit given for \( \lambda \) Ophiuchi, rejecting the W. Herschel observations, which appear to be affected by some error. The period comes out as 150 The same period is suggested for 37 Pegasi, the orbit of which is turned edgewise to us. There are numerous observations of 70 Ophiuchi, Prof. van Biesbroeck thinks that the evidence for an unseen companion is not convincing.

The Schwassmann-Wachmann Nova—The Harvard storehouse of plates has once again proved of great service in tracing the behaviour of this Nova before its discovery. Miss Cannon publishes the following details in Harvard Announcement Card, No. 37. It was invisible (less than mag. 15) in plates of previous years; it first appears on Sept. 11 last, mag. 11·7; it rose to a maximum of 6 0 on Sept. 30; it had fallen to 7 4 on Oct 16, to 8·4 on Oct. 29, to 9 4 on Nov 19. Its spectrum was photographed with the 24-inch reflector on Nov. 20; the hydrogen lines were bright, the line at 4640 being five times as bright as Hs.

# Research Items.

THE MAORI PA. - Bulletin No. 6 of the Dominion Museum, New Zealand, is an elaborate account of the Maori pa or fort by Mr Elsdon Best, which, in addition to a generalised description of form, method of construction, and use, deals with a number of the old pas, though his list does not profess to be exhaustive. In no other part of Polynesia did the fortified village obtain to the extent it did in North Island of New Zealand, and although we hear of strongholds, of which those of Tonga most nearly resemble the Maori pa, nowhere do we find these used more or less permanently as they were in New Zealand. In various islands from the Philippines to Hawaii at intervals, some form of defensive work in stone, tunber, or earth is found; but the custom of living in these fortified villages seems to have been inherited from the first inhabitants of New Zealand, where, apparently, it was a very ancient institution. According to tradition, when Toi first reached New Zealand in the middle of the twelfth century, the Maori found the earlier peoples already using this form of defensive work, and they may have adopted it from them. It may have been spread to other parts by the inter-course between New Zealand and the other islands.

BIRD MALARIA. — The Department of Medical Zoology, School of Hygiene, Johns Hopkins University, is continuing, among other lines of work, the investigation of bird malaria. Dr. E. Hartman (Amer. Jour. Hyg., 7, No. 4, 1927) publishes the results of biometric studies on Plasmodium præcox in the canary. During the rise of the infection in the canary, the asexual forms of the parasite continue to die throughout the cycle The mortality rate is during 21 hours a mathematical constant, as determined by the fit of the data to an exponential curve. The finding of Mrs. Taliaferro was confirmed, that there is a constant rate of increase in numbers of the parasites from day to day until near the peak of the infection. Some cases show a constant rate of decrease of the number of parasites as the infection declines. The relapse cases show the same characteristics of constant rates of increase and of decrease as are exhibited by primary attacks. Relapses may be either more severe or more mild than the initial attack, but they are identical in type of infection. Relapse in bird malaria is usually milder than the primary attack. Symptoms in the bird follow sporulation and peak in numbers. Dr. Mary Stuart MacDougall (in the same journal, No. 5) presents a record of experiments indicating that the increase of the sugar content of the blood brings about a condition favourable for the parasite in bird malaria, and a decrease in the blood sugar by the use of insulin creates a condition unfavourable for the

Self-Fertilisation in Oligochætes.—[During investigations on Tubifex tubifex, L. Cernosvitov (Biol. Zentralbl., Bd. 47, p. 587, 1927) observed specimens in which the spermathecæ were absent. Such worms were, of course, incapable of receiving sperms during copulation. The presence or absence of spermathecæ or the presence of spermatophores in the spermathecæ is easily ascertained in T. tubifex, owing to the transparency of the body wall of the tenth segment in which the spermathecæ are situated. The proportion of worms without spermathecæ varies greatly. It is low (up to 6 per cent.) in collections made in localities where the worms are found in large masses and where the individuals are 8-10 cm. long, that is, under favourable conditions of

growth. In another locality where the worms did not exceed 3.5 cm in length, the percentage without spermathece reached 55 to 70, and in another collection of smaller worms all the specimens were abnormal. The author concludes that unfavourable conditions lead to anomalies in the reproductive apparatus. He isolated worms without spermathece and also worms which possessed spermathece, but in which no spermatophores were present, and in both cases the worms produced eggs which developed normally. Either self-fertilisation or parthenogenesis must therefore have occurred. As there was no difference in the number of chromosomes, he assumed that self-fertilisation had taken place, but in what manner was not ascertained. The author gives the number of chromosomes as not exceeding 76, as against the number 110 stated by Gathy.

Fishes of the Congo Basin.—In a recent report (Srtzungsberichte Akad. Wissensch. Wien, Band 136, Heft 5 and 6) M. Holly continues his descriptions of fishes collected by Dr. Haberer in 1907–8 in the southeast Cameroons. It contains the Siluridæ, Cyprinodontidæ, Acanthopterygii, and the Mastacembelidæ, taken in the Maka district which lies between the Bumba and Ja Rivers, both tributaries of the Congo. The collection has since lain in the Natural History Museum at Vienna. Four new siluriods and one new cichlid are recorded, fully described and figured. The author disagrees with Boulenger on some minor points in the descriptions of other species.

PLAGIOTROPISM.—This tendency of many plant organs to grow horizontally, or at a definite angle to the vertical, is regarded by W. Zimmermann as a 'plagiogeotropism.' He gives a very clear account of his recent experiments in Die Naturwissenschaften for Nov. 11, his original paper having appeared in the Jahrb. fur wiss. Bot., 66, 1927. Experimenting mainly with certain runners, such as those of the strawberry and Ranunculus repens, which can be grown fairly well in darkness, he shows that the position of the runner is determined by gravity, and that the angle to the vertical the runner assumes depends upon the algebraic sum of two internal (positive and negative) geotropic responses of the same organ. As these two opposite responses are not usually of equal strength and are not both at their maximum intensity when the organ is in the horizontal position, the result is a tendency to assume a definite angle in relation to the vertical, which is usually other than 90°, so that the organ grows at an angle to the horizontal. These views certainly seem to bring the phenomenon into line with the interpretation recently given by Gradmann in the same journal (Die Naturwissenschaften, April 15, 1927) of the movements of tendrils and the growth curvatures of twining stems. They do not carry us much farther forward until an interpretation is forthcoming of the internal mechanism of geotropic response.

Chromosome Linkage in Œnothera.—A significant paper dealing with the chromosome linkages which occur in many Œnotheras during diakinesis and the heterotypic mitosis, has been published by Miss F. M. L. Sheffield (Annals of Botany, vol. 41, p. 779). A very critical cytological study of several species and mutations shows a characteristic arrangement of the 14 chromosomes, except in one species in which the arrangement was variable. In two small-flowered species, Œ. novæ-scotiæ and Œ. eriensis, recently described from Canada, there is a closed ring of 14

chromosomes in diakinesis, followed by a regular zigzag arrangement on the spindle, thus determining the normal segregation of only two gametic types in pollen formation. Œ ammophila has one free pair of chromosomes and a ring of 12, while the mutation E. nubricalyx has four free pairs and a ring of 6. Only rarely do departures from these arrangements occur in a plant. The bearing of these important results on the further analysis of mutations in Œnothera is obvious It also appears that the linkage of chromosomes will account for the large amount of linkage of characters which occurs in Œnothera Various schemes of chromosomes interhybrids change and non-disjunction are worked out, in their bearing on the origin of mutations and other complicated problems in this group of plants.

FRUIT CANNING IN THE HOME.—Fruit canning as a home industry is at present almost unknown in England, one of the chief reasons being the difficulty for an unskilled operator to secure a satisfactory seal by soldering the 'hole and cap' can However, a new hand sealing machine, for use with the openended or 'sanitary' can, has been introduced and thoroughly tested at the Campden Research Station Full details for working this apparatus, with illustrations, are given in the Ministry of Agriculture's leaflet, No. 331. Although success depends chiefly on efficient sterilisation, the best results can only be obtained it the fruit for preserving is carefully selected for soundness and uniformity in ripeness. To avoid bleaching in the case of coloured fruit, cans coated with an acid-resisting lacquer can be obtained. Water gives quite satisfactory results as a covering liquid, but a sugar solution is better. The syrup, which must be used boiling, is poured over the fruit and the can sealed immediately, before cooling takes place, to ensure the exclusion of air. The cans are then boiled in water for sufficient time to destroy the enzymes and micro-organisms on the fruit, and finally cooled rapidly in running water to prevent over-cooking. The leaflet concludes with details of the best procedure to be followed in canning most of the common English fruits, as tested at the Research Station, together with a table indicating the best strength of syrup to use, and the time required in the boiling water to effect sterilisation in each case.

Forestry in British Honduras.—The annual report for the year ending Mar. 31, 1927, the fifth year of the Department's existence, has been recently issued. The final Forest Ordmance (Ord. No. 32 of 1926) became law on Oct. 14, 1926. Rules under the Ordinance were sanctioned in December and came into force on Jan. 1, 1927, thus providing for adequate protection of the forests and a stable system of forest finance. Under this Ordinance the contribution to forest trust funds from general revenue during the financial year amounted to 50 per cent. of the total general forest revenue, the balance required being met from the Forest Loan Department. A satisfactory feature of the organisation and management of the new Department is the close co-operation of the latter with the timber exploitation companies Substantial progress, it is said, has been made during the year in many aspects of the sylviculture of mahogany which will have, it is hoped, an appreciable effect in accelerating the establishment of a normal distribution of age classes over the areas in which improvements are being carried out. Arrangements are being made by the Chicle Development Company for intensive research to be carried out on their sapodilla estates in connexion with latex production and economic tapping methods This important work in conjunction with the reafforestation of sapodilla,

the investigations on the increment of Achras sanota. and the examination of the possible utilisation of interior grades of chiele gums from allied species, will have far-reaching effects on the reconstruction of the When it is remembered that the Ficus elastica was practically exterminated in the torests in the east of India by the seventies of last century through ruthless tapping, the steps being taken in the case of the sapodilla form a striking example of the manner in which public opinion is now commencing to envisage such matters Exploration is being commenced in the western highlands between Vaca and the Rio Grande. It is anticipated that the information concerning this little-known locality will be considerably augmented during the trigonometrical work to be carried out by the Survey Department in connexion with the demarcation of the western frontier.

IRRIGATION IN INDIA.—The irrigated area in British India, according to the report for 1925-26 ("Government of India · Department of Industries and Labour (Public Works Branch). Irrigation in India Review for 1925-26." Pp. 10+37 Simla Government of India Press), was 28 I million acres, or nearly a million acres more than in the previous year. The area is 129 per cent. of the total area cropped. In the Punjab the irrigation area was greatest; next came, in order, Madras, Sind, and the United Provinces. Among many projects now in progress to extend irrigation, the following are important The Cauvery Metur project to bring another 300,000 acres under irrigation; the Lloyd dam at Bhatgar in the Nira valley, and the Lloyd barrage at Sukkur on the Indus. The monsoon in India during the year under review was on the average 4 per cent below normal. It was characterised by strength in northern India until the middle of August, when it retreated abnormally early. In the Decean it was weak throughout the season The report contains statistical, including financial, details of the irrigation works in use.

Percolation in a Sandy Seashore. - The form of the surface of separation, under the ground near a sandy seashore, between the salt water which has diffused landwards from the sea, and the fresh water from the rain falling on the land, is investigated by T. Nomitsu, Y. Toyohara, and R. Kamimoto in No. 7, vol. 10 (Sept. 1927), of the Memorrs of the College of Science, Kyoto Imperial University. Herzberg, who had previously considered the problem, assumed that the fresh water was m statical equilibrium, floating on the sea water. The present writers take into account the seaward flow of the fresh water, and also the diffusion of salt into the fresh water underground. An approximate theory indicates that, as in Herzberg's theory, the surface of separation will be parabolic, but in the present theory the form of the parabola depends on the rate of flow of fresh water seawards, and on a certain constant of the soil. Diffusion of salt into fresh water is found to be relatively unimportant. Experiments on models confirmed the approximate theory.

Colloidal Solutions and Ore Deposition.—In recent years Dr. H. C. Boydell has suggested several important applications of the principles of physical chemistry to problems of ore deposition. He has now contributed to the Institution of Mining and Metallurgy a long and masterly presentation of the subject as he sees it. In his absence, the paper was read at the October ineeting by Dr. R. H. Rastall; it is published in the October Bulletin of the Institution. The chief topics dealt with are the processes involved in the precipitation of solids from molecular

and colloidal solutions. The abilities of colloidal solutions to account for many puzzling phenomena are summarised, and their many advantages over true solutions are convincingly recorded. Dr. Boydell missts, however, that he does not advocate colloidal influences to the exclusion of the agency of true solutions. The discussion that followed appears in the November Bulletin. Notable contributions, constructive and helpful in their criticism, were made by Prof J. W. Gregory and Prof. J. C Philip.

THE JAPANESE EARTHQUAKE OF MAR. 7, 1927.— Since the great earthquake of 1923, Japan has been visited by two destructive earthquakes, the Tazima earthquake of May 23, 1925, and the Tango earthquake of Mar. 7, 1927. The epicentres, which were only 11 miles apart, both he near the north coast of the main island and to the west of Wakasa Bay. Of the two, the later earthquake was much the stronger. It resulted, as we learn from a brief but very interesting report by Messrs A. Imamura and N. Nasu, in the loss of 2908 lives (*Proc. Imp. Acad. Tolyo*, vol. 3, pp. 227-231, 1927). Of the houses in the four central counties, 47 per cent. collapsed and 14 per cent were burned. Fault-displacements occurred along two old and independent faults. The Gô-mura fault, to the north, is 11 miles long, and runs N.N.W. and S.S.E., the west side being uplifted so much as 2 feet and shifted towards the south by nearly 9 feet. A short distance to the south of this fault is the Yamada fault, a little more than 4 miles long and running in a direction at right angles to the other Along this fault the north side has a maximum uplift of 16 inches and an easterly shift of 2½ feet. A permanent upheaval of about 21 feet occurred along the Japan Sea coast from the Gô-mura fault westward for about 10 or 12 miles. Soon after the earthquake, seismographs were erected at three stations near the epicentre. The after-shocks recorded belonged to two Those originating near the Yamada fault were of shallow origin, the foci in no case being more than 5 miles deep, while the others, belonging to the Gô-mura fault, originated in foci that were sometimes 121 miles in depth.

TERRESTRIAL MAGNETISM AT SAMOA.—The Apia Observatory, Samoa, was founded in 1902 by the Gottingen Academy, originally for three years, and later as a permanent institution. When Samoa was occupied by New Zealand troops in 1914, the observatory was taken over by the N.Z. Government; the German director, Dr. G. Angenheister, with a staff of assistants, remained in charge until 1920, when arrangements for the further maintenance of the observatory were concluded between the N.Z. Government, the British Admiralty, and the Carnegie Institution of Washington. Dr. Angenheister was succeeded by Mr. C. J. Westland as acting director, and afterwards by the present director, Dr. Andrew Thomson. The reports of the observatory under the new regime have been issued for the years 1921 to 1923 (the last appearing in 1926), giving hourly values of the magnetic elements, and summaries of the observations on meteorology, seismology, and atmospheric electricity. Under arrangements with the New Zealand Government, Dr. Angenheister took with him on his return to Germany the observations taken under his direction, in order that he might reduce and discuss them. A summary of these data for the years 1912-1920, so far as they relate to terrestrial magnetism, has recently been issued, under the editorship of Prof. D. M Y. Sommerville, of Wellington College, N.Z. It is to be hoped that this valuable summary will later be supplemented by the publication of the actual hourly values. The observations at Samoa are of particular importance, owing to the extreme paucity of magnetic observatories in the southern hemisphere, and to the great distance of Apia from the next nearest observatory. The value of the data is naturally enhanced by the now considerable period over which observations have been made there.

Rubber Sulphur Compounds—Paper No. 560, by Curtis, McPheison, and Scott, published by the U.S. Bureau of Standards, gives the density and electrical properties of the compounds of rubber and sulphur for the range of composition from 0 to 32 per cent. of sulphur, that is, from crude rubber to hard lubber. Important changes in the properties with the proportion of sulphur are noted. These changes show definite regularities and occur at compositions which may be represented by simple empirical formulæ The authors conclude that this indicates the existence of definite compounds of rubber When the composition contains 19 per and sulphur cent. of sulphur, all the properties that were studied undergo significant changes. At this composition the slope of the curve connecting density with percentage of sulphur changes; so also does the curve showing the thermal expansion to percentage of sulphur Both the specific inductive capacity and the power factor curves pass through minimum values at 19 per cent. of sulphur, while the resistivity curve bends The specific inductive capacity has a very upwards decided maximum value when the composition is 105 per cent of sulphur. The power factor shows a maximum at 13 5 per cent, whilst the resistivity does not attain its maximum value until the percentage is Experiment showed that the effect of free sulphur on the electrical properties was small compared with the effect of the combined sulphur. Electric strength measurements are not recorded, because it was found that they seemed to be affected more by the conditions of the test than by the properties of the compound

THE ATTENUATION OF RADIO WAVES OVER LAND.— Mr R H. Barfield read an important paper on Dec 7 at the Institution of Electrical Engineers on the attenuation of radio waves when passing over land. The intensity of the London broadcasting station  $(2LO; \lambda = 364 \text{ m.})$  was measured in seven different radial directions, up to distances of about 100 miles. The over-all attenuation coefficient was then found from the experimental results and compared with results obtained by Sommerfeld's theory. The numbers found experimentally were much greater than the theoretical numbers. It is suggested that this discrepancy can be explained by the well-wooded nature of the English countryside. The energyabsorbing property of individual English trees was measured experimentally, and calculations are made for given densities of tree distribution founded on these results. It is concluded that the greater part of the discrepancy between theory and experiment can be ascribed to the trees. The experimental results show no evidence of screening or other effects produced by hills. The directions investigated included routes over the North and South Downs and the Chiltern and Cotswold ranges. It is proved that about 1600 trees per square kilometre will have an attenuating effect equal to that of the earth in the given experiments. In particular, actual counts in the districts north of London give 500 trees per square kilometre, and in the districts south of London about 4000 trees per square kilometre. Calculations based on the latter number give the observed value to the attenuation coefficient, but the agreement with the north of London routes is not good. Probably hedges and other vegetation, houses and other erections, contribute to the absorption produced

# The Hungarian Biological Research Institute.

By Dr. F. A. BATHER, F.R S

ON Sept. 5 the Regent of Hungary, Admiral Horthy, inaugurated the new buildings of the Hungarian institute for biological research at Tihany on the shores of Lake Balaton (Fig. 1). This institute has been founded through the exertions of the Minister for Education. Count Kuno von Klebelsberg, in pursuance of the general policy of the Government to restore the various cultural institutions of Hungary to the same high level as they occupied before the War, and where possible to raise the standard. It is gratifying to note the importance which His Excellence has attached to the development of the natural sciences. During his term of office one new university has been founded, and two rendered homeless as a consequence of the War have been re-established

of an age ranging from Miocene to Permian. This is particularly the case at Tihany, where Eocene rocks capped by basaltic tuff form a peninsula which stretches more than three-quarters of the way across the lake. On the summit of the cliff stands the Benedictine abbey, founded in 1054, and on the strip of shore at its foot, between a small hotel and a villa of the Archduke Joseph, is the site of the research institute, enlarged to about four acres by building out on the shallow sandy lake floor. This site will be occupied by four main blocks. the laboratory building, lodgings for visiting workers, residence of the staff, and an aquarium open to the public, only the first two are completed.

The laboratory building consists of basement,

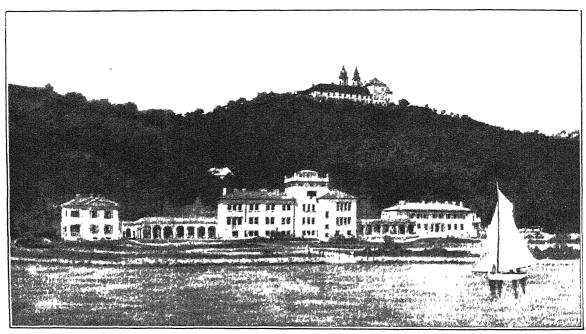


Fig. 1.—Hungarian Institute for Biological Research, Tihany, Lake Balaton.

in fresh situations. Among the new developments may be mentioned the excellent modern equipment of the medical faculty at Debrecen, but the support accorded to pure biological research through this institute at Tihany is a still more manifest sign of this enlightened policy.

The present institute was founded in 1926 in continuation and development of the Biological Station which was maintained at Révfulop by the Hungarian National Museum. Work will continue in co-operation with other laboratories in Hungary, but the new situation and the admirable arrangements will greatly facilitate research.

Lake Balaton is the largest piece of fresh water in the south of Europe. With a length of 51 miles, it varies in width from two to nine miles, and attains in places a depth of 425 feet. It is rich in fishes and other forms of life. While the southern shores are low and flat, those on the north are formed by picturesque hills sloping steeply to the water. These hills owe their existence to a capping of Phocene basalt and other volcame rocks, which have preserved from complete erosion the underlying softer rocks,

raised ground floor, first storey, and a tower which adds another storey, and a flat roof with a small room on it. The institute is organised in two departments. The first, which occupies the ground floor, and is immediately under Dr. Béla Hankó, administrative director of the Institute, is devoted to zoology, botany, and hydrobiology. It contains the reception room and the laboratory of the director, the library, a laboratory for the botanist, one for the bacteriologist, a microscopical laboratory with six tables, and a room for the laboratory assistants.

The second department, which is on the first floor, conducts physiological, physical, and chemical research, and is directed by Dr. F. Verzár of Debrecen It contains the laboratory of the director of the physiological assistant and a laboratory for the official chemist, two laboratories for single research workers, a balance-room, and an assistants' room. There is also a large laboratory for demonstrations to twenty students.

The tower contains an optical room, a drawing and photographic room, with a dark room, and the cisterns for Balaton water and artificial sea-water.

On the roof will be placed meteorological instruments. In the basement are workshops, store-rooms, engine rooms, and mechanician's lodging, a cold aquarium, fish-breeding plant, and a room protected against tremors by special pillars, and thus permitting of the finest physical measurements and photographic work

Each working-place has a double aquarium with flowing Balaton water and aeration, a supply of three kinds of electric current, of gas made in the institute from benzol, of compressed air and vacuum draught, and of drinking water, and a hot-water heating apparatus. Water is sucked from a point 200 metres out in the lake, through a pipe of eternite into three successive basins, where the sediments settle, and is then sent by a bronze centrifugal pump to the cisterns in the tower; these last are painted with innertol, and the water supply pipes in the building are of lead The working aquaria are modified from the Naples model, three of them can receive artificial or actual sea-water, which is stored ın a stone cıstern.

The thermostats, kymograph, nephelometer, and colorimeter, lighting, photographic, and all other apparatus are of the very latest and best design

m whatever country that could be found The lodgings in the adjoining block provide twenty-six beds, in fifteen rooms; these are at present partly occupied by the staff There are also a dining-room, servants' bedrooms, and the usual offices.

The programme of the Institute is, first, the biological investigation of Lake Balaton and other Hungarian waters; but it will undertake all kinds of research in general biology and physiology for which its resources are adapted. At certain times educational courses will be conducted, especially for teachers in secondary schools. It is particularly hoped that foreign workers will avail themselves of the facilities offered Tables will be allotted to them according to the available room. A monthly fee of 125 penzo (about 14s. 4d) covers a fitted working place, lodging, and research material up to 25 penzo (say 3s.). A place can only be retained so long as it is really used for work. His Excellence the Minister of Education expressed to me the wish that it might be possible to arrange for an exchange of similar facilities between Tihany and similar laboratories in the British Dominions at home or overseas, he would also be glad to see an exchange of publications. Should the publication of this appeal in Nature meet the eyes of the very variously constituted bodies that govern such institutions within the British Commonwealth, they will doubtless respond to it in a friendly spirit. Those who wish to have complete sets of the Annals and other publications of the institute should not wait until the earlier numbers are out of print. Correspondence may be addressed to the Director, Dr. Hankó, Magyar Biológiai Kutato Intézet, Tihany, Balaton, Hungary.

# The Undercooling of Some Aluminium Alloys.

ALTHOUGH the undercooling of pure metals was observed by Roberts-Austen so long ago as 1898, no experimental data have so far been published regarding the supersolubility curves of alloy systems, although explanations of certain structures have been based on their existence particularly in regard to The recent May Lecture of Sir Henry

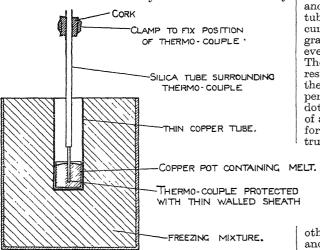


Fig 1.—Diagram of apparatus

Miers to the Institute of Metals on "The Growth of Crystals in Supersaturated Liquids" is now followed by a paper by Dr. Marie L. V. Gayler, delivered before the Institute of Metals on Sept. 7, on the effects of undercooling in some alloys of aluminium, in par-ticular with silicon. The work was carried out for the Engineering Research Board at the National Physical Laboratory under the supervision of Dr. W. Rosenhain and breaks entirely new ground. For the first time the supersolubility curves for an alloy system are available, and with their aid an explanation of the structures of the aluminium-silicon alloys can be offered with a considerable degree of certainty.

The experimental method adopted consisted in melting the alloy in a thin copper pot, the wall thickness of which did not exceed  $\vec{r}_1$ , in , raising the melt to a temperature of about 200° C. above the liquidus and then quickly dropping the pot into a copper tube immersed in a freezing mixture. A cooling curve was obtained on a Rosenham plotting chronograph, readings being taken every 10° C. at first and every 5° C after the first arrest had taken place. The general arrangement is shown in Fig I <sup>1</sup> The results are represented by the dotted lines in Fig. 2, the continuous lines in the latter indicating the temperatures of the changes as normally accepted. The dotted lines indicated in Fig. 2 are thus representative of a definite rate of cooling, but there are good reasons for the belief that they approximate closely to the

true supersolubility curves. In the first place, as will be shown later, they offer good grounds for the mterpretation of the microstructure observed in the ingots, but far stronger reasons for this

belief lie in the following facts.

As is well known, the aluminium-silicon alloys are normally more or less brittle. When, however, to the melt is added a small trace of sodium or other 'modifying' material, their mechanical properties and structures are radically effected. If the 'modification' is due to crystallisation along the supersolubility curves, it should follow that the freezing curves after modification should at any rate approximately coincide with the latter curves themselves. Secondly, the 'modification' should inhibit the attainment of a second series of supersolubility curves lying below those previously obtained. Miss Gayler has shown that both these results can be obtained. The freezing diagram obtained from the 'modified' alloys lies remarkably near to that of the supersolubility curves in Fig. 2, and systematic under-

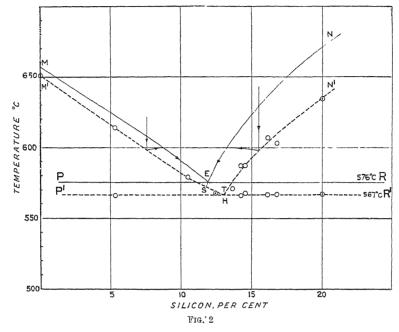
<sup>1</sup> This and other illustrations are reproduced by courtesy of the Institute of Metals

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cooling does not occur in the 'modified' alloys, supersolubility curves for which could, therefore, not be obtained.

The correlation of the foregoing curves with the microstructures is excellently effected. In Fig 3, it

structure of which is shown in Figs 4 and 5, however. silicon separates first at some point on the supersolubility curve N'II The composition of the liquid then follows NS until S is reached, when aluminum separates spontaneously; the course of the liquid



will be seen that besides the primary dendrites of aluminium, coarse silicon is present; this suggests that in this alloy, containing 10 per cent. of silicon, aluminium separates on cooling at a point on the super-solubility curve M'H in Fig. 2. The composition of

then probably oscillates between SH and TH until the point H is reached, when aluminium and silicon separate together It will be seen in Fig. 5 that the primary silicon is surrounded by dendritic aluminium. The structures of the ingots obtained are of much

Fig 3.-100 per cent silicon. Centre of ingot

the liquid then follows MET until the silicon supersolubility curve is reached at T, when silicon separates along TH until the hypertectic point H is reached and both constituents separate simultaneously. In the alloy containing 13.2 per cent. of silicon, the

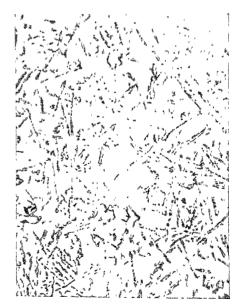


Fig. 4-13.2 per cent. silicon Edge of ingot.

interest, and the results may not improbably throw considerable light on the general question of ingot crystallisation. Contrary to what would, perhaps, generally be expected, since the outside of the ingot must be the more rapidly cooled, the structure of the

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outside rim to a depth of approximately 1. in is much coarser than that inside. The character of the crystals is also different, particularly that of the silicon,

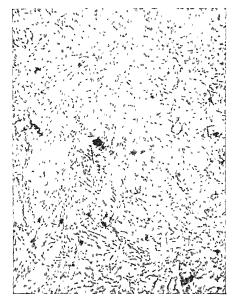


Fig 5-13 2 per cent silicon Centre of ingot ×150

which takes a definitely needle shape, while the silicon in the centre of the ingot is in more rounded particles and much finer needles. F. C. T.

# University and Educational Intelligence.

LONDON.—The title of emeritus professor of pathology in the University has been conferred on Sir Frederick Andrewes, who retired from the University professorship of pathology tenable at St. Bartholomew's Hospital Medical College in July last.

The Senate has decided to make a grant of £200 a year for five years towards the cost of maintaining the British Institute in Paris.

The following doctorates have been conferred: D.Sc. in Chemistry—Miss P. V. M'Kie (Bedford College), for a thesis entitled "The Interaction between Nitric Acid and Unsaturated Compounds", and Mr. A. W. Chapman (Imperial College (Royal College of Science)), for a thesis entitled "Studies of Isomeric Change—with special reference to the Molecular Rearrangement of Immo-aryl Ethers." D.Sc. in Zoology—Miss H. S. Pearson (University College), for a thesis entitled "On the Skulls of Early Tertiary Suidæ, together with an Account of the Otic Region in some other Primitive Artiodactyla." D.Sc. in Veterinary Pathology—Mr. F. C. Minett, for a thesis entitled "The Standardisation of Immune Serum and the Nature of Immunity in Foot and Mouth Disease," and other papers.

A free public lecture on "Recent Discoveries throwing New Light on some of the Commonest Insects" is to be given by Prof. E. B. Poulton, at Bedford College for Women, at 5.15 on Jan. 31.

With the view of encouraging original research in sanitary science, the Grocers' Company is offering scholarships of the annual value of £300 each, plus a further amount for expenses. The scholarships are tenable for one year, but renewable up to three years. A form of application can be obtained from the clerk of the Grocers' Company, Grocers' Hall, E.C.2.

The Pan-American Union has issued in Washington, D.C., two pamphlets containing the projects of the International Commission of Jurists, "Public International Law" (pp. 40), and "Private International Law" (pp. 68). These drafts are the findings of sessions held at Rio de Janeiro in April and May 1927, and are to be submitted for the consideration of the sixth International Conference of American States which will convene at Havana, Cuba, in January 1928. Under Public International Law two of the earlier projects are (v) Exchange of publications and (vi) exchange of professors shall be paid by the institution which has appointed him, unless his services shall have been expressly requested, in which case his remuneration shall be borne by the institution which invited him. In Private International Law, Chap, it is on domicile: "The domicile of diplomatic officials and that of individuals temporarily residing abroad in the employment or commission of their government or for scientific or artistic studies, shall be the last that they had in their own territory."

The annual meeting of the Science Masters' Association will be held on Jan. 4-6 at the Imperial College of Science, under the presidency of Sir Richard Gregory. Evening meetings will be held at King's College for Women, Campden Hill Road, Kensington, W.8, where the presidential address on "Contacts of Science and Literature" will be delivered on Jan. 4 The programme includes discussions on the nced of scientific investigators for the agricultural industries overseas, to be opened by Sir J. B. Farmer and Capt Irby (Colonial Office), and on industrial openings in scientific technology, to be opened by Prof. W. A Bone, and lectures by Dr. J. W. T. Walsh on modern methods in photometry and by Prof. J. C. Philip on charcoal and its activation. Visits have been arranged to the London docks, the United Dairies, Ltd., the Lighting Service Bureau, the Gas, Light, and Coke Co., and to the new laboratories at Highgate School. During the meeting there will be exhibits by members of the Association and by instrument makers and related firms, and also a display of books by leading publishers. Correspondence should be addressed to the organising secretary, Mr. I. M. Bankes-Williams, at the Chemistry Department, Imperial College of Science, South Kensington, S.W.7.

THE October number of the University Bulletin, issued by the Association of University Teachers, contains a report on the representation of teaching staffs upon university bodies. This is the outcome of the labours of a committee appointed to inquire into the subject. A sufficient warrant for undertaking such an inquiry is to be found in the University Grants Committee's report of 1925, in which attention was directed to the reasons why lecturers as well as professors should be accorded a more clearly recognised position in the government of the universities, and, in particular, why they should be represented on the executive governing bodies. Appended to the report of the Association's committee, which concludes by reaffirming the opinions of the University Grants Committee, is a useful tabular statement showing the actual position in the civic universities of England and the University of Wales In the same number appears, under the title "Jottings from the University of Utopia," a summary of advanced views on adult education, vocational guidance, and "earning while learning." In an article on the "wider aspects of extra-mural work." emphasis is laid on the value to the civic universities of their adult education work as a means of keeping them in touch with public opinion in the regions they serve.

#### Calendar of Customs and Festivals.

January I.

FEAST OF THE CIRCUMCISION -New Year's Day. marked in the Christian Calendar as the Feast of the Circumcision, being the eighth day after the day fixed by the early Church as the birthday of Christ, which coincides with the great mid-winter festivals of paganism The ceremony of circumcision, usually, though not invariably, a puberty or initiatory ceremony among races practising the rite, was performed by the Jews on the eighth day after birth. Circumcision was an essential condition of participation in the Passover and was enjoined on every male member of each household, including slaves, and on proselytes. In the case of the latter, however, it became later a subject of acute controversy. A widespread custom among modern peoples, especially in Africa, its origin and purpose are obscure. It was practised by the ancient Egyptians, but probably was not originally a Hebrew or even a Semitic rite, although the use of a stone to circumcise the son of Moses, as is usual when an obsolete instrument or material is used ceremonially, is an indication of high antiquity. attribution of its practice to Abraham may be taken as a mythical explanation of its significance in Jewish ritual as a mark of the right of admission to or a condition of participation in the most important of Hebrew ceremonial observances.

NEW YEAR'S DAY.—Although the entry upon a New Year has not always and everywhere taken place upon Jan. 1, its proximity to the winter solstice. when the sun turns to an upward path, made this a peculiarly acceptable date to peoples of the northern hemisphere, where there is a marked difference between winter and summer. Among other seasons which have served for the beginning of a new annual period are early spring or late autumn, at about the time of what is now All Souls, coinciding respectively with the awakening and the closing of the activity of vegetation—the turning points of the Celtic year the rising of the Pleiades or the end of the harvest. while the ancient Egyptians, in theory, regulated their

year by the heliacal rising of Sirius.

Whatever the period of the year adopted, the practice common to many peoples is to prepare for the new era as the old year draws to a close by a period of ceremonial purification which drives out evils and especially the spirits and ghosts of the dead, this being followed by a time of rejoicing, just as in the English Church the peal of bells welcomes the New Year after the solemn vigil of the Watch Night. In the Andamans at the end of the monsoon, the spirits which haunt the village are collected in leaves which are thrown into the sea The pagan tribes of Borneo send the spirits of evil floating away in little boats.

In Great Britain there are still traces of this desire to be rid of the influences of the past. Sometimes old clothes are burned on New Year's Eve. New clothes, or at least some one piece of new clothing, must be worn or no good luck will follow. A significant custom of the Strathdown Highlander in Scotland enjoined the drinking of water from the "dead and living ford," an aspersion, and a fire of jumper branches gathered for the purpose on New Year's Eve and put to dry all night, which made a stifling smoke in all the house, as a necessary preparation for the rejoicings of New Year's Day. Horses and cattle were also fumigated.

Many primitive peoples practise the ceremony of the scape-goat at the New Year, the sins and ills of the community being borne away by the animal, goat or other, when it is driven out. Possibly the same idea lies far behind the custom once followed in

Cumberland and Westmoreland of riding on the stang,' a piece of timber, all who refused to contribute to the merrymaking expenses of the party

carrying the stang.

Most modern New Year's customs, while involving the element of merrymaking, in their relation to belief-religious in a broad anthropological senseare originally connected with omens, forecasting fortune in the coming year, the omen becoming, as often, by intentional performance an ensurance of good luck. A man, not a woman, and dark and not fair, should be the first to cross the threshold on New Year's morning. Something should be brought into the house, even if only a piece of coal, before anything is taken out; some new garment should be worn. Hence the custom of 'first footing'—the house-tohouse visits after twelve o'clock of parties headed by a dark man bearing food and drink, thus ensuring prosperity to the house during the coming year custom of New Year gifts, now more common perhaps on the Continent than in England, goes back to the Romans and beyond—a custom in which the early Christians were forbidden to join. The ceremonial cutting and distribution of the mistletoe by the Druids in the New Year, a practice now transferred to Christmas, was intended to ensure the same prosperity among the worshippers throughout the year.

EPIPHANY. TWELFTH NIGHT. OLD CHRISTMAS DAY. Twelfth Night marks the end of the celebration of the Christmas or winter festival, though there is evidence for a period of twenty days which was sometimes prolonged until Candlemas It is especially associated with honour to the Three Magi or kings who brought gifts to our Lord, in memory of whom royalty used to make offerings of gold, frankincense,

or myrrh on this day

The customs of Twelfth Night fall into at least three groups. The best known were connected with the feast, with a regular ceremonial, which for long was observed by all from royalty downward in England, France, Germany, and other countries, though when celebrated by Mary Queen of Scots it was recorded as a French custom. This ceremonial included the election of a king, known as the 'King of the Bean,' and sometimes a queen, and a ceremonial cutting of the Twelfth Night cake, in which was included a bean or com, allotting the office of king, and sometimes other gifts, foretelling varying fortune for those who obtained them. In Herefordshire a holed cake was made which was placed on the horn of an ox in the stable, and according as he tossed it in the direction of the bailiff or the mistress, it became the perquisite of either.

The election of a king or 'Lord of Misrule' points

to that frequent subversion of law and order in certain types of festival such as the Saturnalia and the Carnival, which derives from the primitive abandonment of all social regulation and the prevalence of complete sexual licence at certain stated seasons for the magical promotion of fertility in Nature. In the west of England it was the custom to light fires in the fields or on the hill tops. In Gloucestershire thirteen fires represented our Lord and the twelve apostles, and in Brough in Westmoreland holly bushes with torches attached were carried round the town. These customs are comparable with the ceremonial bonfires at midsummer and other times of the year.

A fertility ceremonial is also recorded. In Cornwall, Devon, and Herefordshire, it was the custom to visit the orchard, and after firing a gun, which would drive away the spirits of evil, to pour a libation of cider over the apple trees, while a verse—a charm to secure a good crop-was recited.

#### Societies and Academies.

#### LONDON.

Linnean Society, Dec. 1—A T Hopwood: Exhibition of vertebrate remains from the Miocene of Kenya Colony. These specimens are the first mammals from beds older than the very top of the Phocene recorded from the eastern half of Central Africa. The collection contains three genera of creodonts, two of artiodactyls, and three or four of rodents containing some seven or eight species. The rodents are closely allied to those living in the region at the present day.

Society of Public Analysts, Dec 7 -Harold Toms . Oil bromine films and their use in determining the halogen absorption of oils Oil films exposed to an atmosphere of bromine absorb the halogen quantitatively, and, after removal of the excess of bromine at a low temperature, the bromine absorption can be determined gravimetrically. The method, which gives accurate results with 20-50 mgm of an oil, has been used to determine the composition of the insoluble bromide of linseed oil, after removal of the bromine, by prolonged treatment with nascent hydrogen. The iodine values, calculated from the bromine absorbed. agree with those obtained by the Wijs method, except in the case of tung oil, the gravimetric bromine absorption of which stands in a constant relationship to the rodine value -G. Middleton and F. C. Hymas. Tests for impurities in ether. (1) Tests for peroxides Only organic peroxide (probably dihydroxydiethyl peroxide) is to be expected in ether purified for anæsthesia. The ferrous thiocyanate test is recommended for official adoption, and a colorimetric limit for the amount of peroxide is proposed gives no coloration with pure ether, and is not too stringent for practical purposes —H. J. Stern: Arsenic in coated papers and boards. Mineral pigments are usually satisfactory, but some of the synthetic in-organic pigments may be dangerous. Thus, a paper coated with an arsenical green may contain more than 6 gm. of arsenious oxide per square metre Some of the lakes of synthetic dyes, notably magenta and methyl violet, precipitated with arsenious oxide, contain dangerous amounts of arsenic (e g 40 5 per cent. of As<sub>2</sub>O<sub>3</sub>). Certain dyes, notably Pigment Scarlet 3B and Orange II, may contain 50 to 100 parts of arsenic per million. A provisional arrangement is in force limiting the amount of arsenic to 10 parts per million, and the boards in use seldom contain more than 2 or 3 parts per million.

#### CAMBRIDGE.

Philosophical Society, Nov. 21.—D. R. Hartree: The wave mechanics for an atom with a non-Coulomb central field. The methods developed can be applied to find the self-consistent field of an atom, that is, a field such that the solutions of the wave equation for that field which corresponds to core electrons give a distribution of charge which reproduces the field. Approximations to the self-consistent fields for He, Rb<sup>+</sup>, Na<sup>+</sup>, Cl<sup>-</sup> have been worked out; for the normal state of He the characteristic value of the wave equation for the self-consistent field gives an ionisation potential of 24.85 volts (obs. 24.6 volts), the most extensive work is for Rb, for which the general agreement between calculated characteristic values and observed terms of optical and X-ray spectra is satisfactory.—W. H. McCrea: The specific heat of hydrogen at high temperatures. The specific heat of hydrogen calculated from the empirical energy levels found by T. Hori from the H<sub>2</sub> band spectrum is in good agreement with experiment,

especially for temperatures in the neighbourhood of 2000° abs. Similar calculations for oxygen, nitrogen, and carbon monoxide do not give agreement with observed values.—S. L. Malurkar. On the arc spectrum of antimony. The arc spectrum of antimony has been arranged as due to the combination of about thirty levels which are denoted by  $3d_2d_1$ , 1s,  $3D_2D_1$  and Greek letters by Ruark-Mohler, Foote, and Chenault. It was possible to fix approximately the nature of these levels after the Hund-Heissenberg theory of complicated spectra. A note is added on the arc spectrum of arsenic

#### DUBLIN

maintenance requirements of cattle on different rations and at different rates of production; with a note on 'dynamic action.'"—J Wilson The maintenance requirements of cattle A reply to E B. Forbes's criticism.—D. T. Barry and J. Freud. Some experiments on feeding rats with soya bean and other materials Feeding white rats on soya bean and its products causes some diarrhea, but no avitaminosis is noted as compared with meat On white flour alone, avitaminosis was evident and also protein deficiency in one case by the animal eating its tail. This was corrected by meat. Soya products are good supplementary foodstuffs.—E. T. S. Walton: The formation of vortices behind a cylinder moving through a fluid. A large number of photographs have been taken of the vortex trains behind different cylindrical rods moving through water at various constant velocities, the drag on the rod being also recorded in each case. The experiments were undertaken to test Kármán's formula for resistance  $R = \rho h h / \tau$  and the modified formula of Synge, involving an additional term. The velocity of the vortices was found to be u=0.146U, which is about one-third of the value obtained on Kármán's assumption  $\kappa = Ul$ . For large Reynolds's number the resistance was found to agree approximately with Kármán's formula, when the values obtained by experiment were substituted on both sides of the equation. The additional term in Synge's formula was less than the experimental error. Graphs are given connecting the dimensionless quantities  $D/U\tau$ , u/U,  $R/\rho DU^2$ ,  $\iota/lU$  with the Reynolds's number —J Bayley Butler and J. J. C. Buckley. Catenaria anguillulæ as a parasite of the ova of Fasciola hepatica The infection arose in some ova of the fluke that had been kept in the laboratory nearly nine months, and is believed to have been introduced through changing the water in the testtubes. The cultures are readily grown on living and dead ova, and a large percentage of eggs exposed to infection become infected within a week. The development of the zoospore, the formation of sporangia and the re-infection of other eggs by zoospores, were described.

#### LEEDS

Philosophical and Literary Society, Nov. 15.—W. F. Beard: On the occurrence of a determinantal system of points of the fourth order.—F. A. Long: An electromagnet giving large fields. An electromagnet is described which gives considerable fields in a wide gap with small power consumption. It includes an oil-cooling and insulating system and a device to prevent a large E.M.F. developing on breaking or changing the current.—D. Brown: Further experiments on electron reflection. An account of an investigation into the energy of low-speed electrons after striking hot and cold oxide surfaces. The results suggest that whereas a hot oxide surface

behaves like an ordinary good conductor, the cold surface, by reason of its semi-insulating character, becomes electrically charged, thus influencing the energy of the reflected electrons—E. W. Smith: The oxidation of branched chain aliphatic acids. The results indicate an increasing ease of oxidation in the series isobutyric, isovaleric, isocaproic, isoheptylic These qualitative experiments were carried out chiefly to explore the suitability of this series of acids for definite measurements of their initial velocity of oxidation -H. M Dawson. The coordination of the catalytic effects produced by an acid in different reactions and a modified form of the generalised catalytic equation. An alternative form of the general equation which co-ordinates the catalytic effects of hydrogen ion and acid has been derived. The ratio of the quantities of salt which are required to reduce the reaction velocities of two different reactions to their respective minimum values depends on the square root of the ratio  $k_h/k_a$ For a given catalysing acid this salt ratio is independent of the concentration of the acid.-J H. Priestley and Dorothy Tong · The effect of gravity upon cambial activity in trees Gravity modifies the activity of the cambium in horizontal woody stems. In the Dicotyledon it increases wood formation and retards lignification on the upper side of the stem and decreases wood formation and accelerates lignification on the lower side. There are numerous exceptions to this rule in Nature. In the Gymnosperm the effect of gravity is to produce more wood with thicker walls and greater lignification on the lower side. There are very few exceptions to this rule. That in all cases lignification and the thickening of the wall proceeds more quickly on the lower side of the branch. explains the fact that on this side the wood elements are shorter and therefore better able to resist compression, while the longer elements on the upper side resist tension better. The different behaviour of Dicotyledons and Gymnosperms is correlated with other differences in cambial activity in these two groups.

#### Paris

Academy of Sciences, Nov. 28 .- V. Grignard and G Mingasson: The reduction of acid chlorides under reduced pressure: method of preparation of aldehydes. With nickel or nickel chloride as catalyst, at a temperature of 225° C. hydrogen at a pressure of 140 mm. reduces benzoyl chloride to benzaldehyde, with a yield of 60 per cent. At 200° C, with hydrogen under 400 mm., phenylacetyl chloride gives a 50 per cent. yield of the aldehyde. The chlorides of fatty acids under similar conditions also give aldehydes, but the yields are poor, probably owing to the higher vapour pressures of the aldehydes produced. Alexandre Pantazi: The projective applicability of developable surfaces—Paul Mentré: The flecnodal complex of a ruled surface.—J. A. Lappo-Danilevski: General algorithmic solution of the regular problem of Riemann.-Nicolas Mouskhelichvili: The approximate integration of the biharmonic equation.—Basile Demtchenko: Disturbing forces acting on a body which moves in a liquid near a wall.—A. Lévèque: The theoretical solution of the problem of heat exchange by the circulation of a viscous fluid in steady motion inside a cylindrical tube.—René Darbord: New method for the absolute measurement, at high frequencies, of the dielectric constants of liquids. special form is given to the condenser and the result is unaffected by the dispersion of the lines of force.— L. Cagniard: The variation of the dielectric capacity of fluids in intense electric fields. The apparent diminution of the dielectric constant is due to a parasitic phenomenon which it is not possible to eliminate

completely, and proves nothing for or against the existence of dipoles -- C. Gutton and Mme J. Mihul: The permeability of iron at high frequencies.—A. Piccard and E Stahel . The absence of the other wind at the Rigi The experiments of Miller were not confirmed -C Eichner The decomposition of the vanadyl sulphates at high temperatures - Marcel Godehot and Mile Cauquil Some derivatives of the cyclo-octane series. The preparation and properties of a new alcohol, cyclo-octanol, are given - F. Hermann. New conceptions on the tectonic of the Franco-Italian Alps - René Souèges: The embryogeny of the Leguminosæ: the last stages of the development of the embryo in Medicago Lupulina - L. Blaringhem The heredity of sex in hybrids of pinks, and especially in Dianthus barbatus × D caryophyllus -- L. Lavauden: Some effects of the dry climate on the higher vertebrates of northern Africa Study of the changes produced by several very dry seasons. the most marked result was the cessation of reproduction both in mammals and birds - The Cahn and A. Bonot: The demonstration of the existence of reserve proteids in the liver of mainmals - K. M Bykow and Alexeiew Berkman: The creation of reflexes conditional on diuresis.—Philippe Fabre Distinction between measurements of excitability and measurements of neuromuscular velocity of excitability: a new test of excitability—(; M Frank and S. J. Salkind: The mitogenetic radiation of the eggs of the sea-urchin. The mitogenetic emission of impregnated eggs takes place only during the second hour: it precedes the cell division This is in agreement with the hypothesis of Gurwitsch.—Mile L. Dehorne. A chiated parasite of Clitello arenarius. Its relations with Opalma (Anoplophyra) filum of Claparède - G. Guittonneau, Mnie. J. François Perey, and Mile. M. Béjambes. The protozoa of the soils of Agenais.-J. Legendre: Races of Stegomya fasciata and yellow fever-Selman A. Waksman and René J. Dubos: The nature of the organisms which decompose cellulose in arable soils

#### GENEVA.

Society of Physics and Natural History, Oct 20.-Fernand Chodat: Results of an atmometric inquiry at the "La Linnæa" alpine garden. The author communicates results of the application of atmometric methods to plant ecology. The experiments clearly show that with a new quantitative index, the atmometric index (numerical value of the evaporation of the place studied), it is possible to complete the ecological description of a plant station.—Raoul Pictet: Experimental demonstration of the potential of the ether. Its consequences in the physical theory of the properties of vapours and gases. In support of his theory on the reality of the ether, the author indicates an experimental scheine which would tend to confirm the results described in a previous note. Arthur Schidlof: The interpretation of the masses of the electron and the proton in the universe of five dimensions. Keeping all the other premises of the theory of the five-dimension universe of O. Klein, but relinquishing the supposition that the Einstein element of space-time ds is an invariant, a unique equation is obtained for the electron and proton which allows an interpretation of the fact that the change of sign of the electric charge gives as a consequence a value of the true mass of the proton 1840 times as great as that of the electron.

#### ROME.

Royal National Academy of the Lincei: Communications received during the vacation.—U. Cisotti: The divergence of tensors.—G. Abetti: Observations of the partial solar eclipse of June 29, 1927, carried out al,

Arcetri — A. Angeli · The biochemical transformation of tyrosine into pyrrole derivatives Tyrosine is convertible into pyrrole derivatives by the action of oxidising enzymes and into 5 6-dihydroxymdole by means of tyrosmase, and Bloch suggests that the melanins are formed from hydroxytyrosine under the influence of a special enzyme, termed dopa-oxydase Since, however, hydroxytyrosine has not yet been detected in the animal organism, and extracts of melanotic tumours do not colour tyrosine, although they readily blacken with pyrrole, it seems probable that, in such cases, the formation of melanin is due to the less complicated oxidation of products containing ready-formed pyrrole nuclei in their molecules —G Lampariello: The theorem of the derivation by series -B. Colombo. The transformations (m, n) between m+n+4 integrals of two equations to the partial derivatives of the second order in two independent variables -- A Colacevich. Estimates of the magnitude of the Pons-Winnecke comet. Naked-eve, binocular, and equatorial observations of this comet made in June give for its magnitude values varying from 4.7 to 9.3 The nucleus appeared to be stellar, especially during the period June 20-26. Indications of a tail were discernible by means of the equatorial, the length from the nucleus being 8' The head appeared as a circular nebulosity of radius 4'—L. Fernandes Complexes of uranyl with polyphenolic acids. Addition of orthoxynaphtholic acid to a solution of uranvl acetate results in a red coloration, which becomes accentuated as alkaline carbonate is added. If this addition is arrested when the solution is neutral or faintly alkaline, a complex derived from the acid  $[UO_2(C_{10}H_8O \cdot CO_2)_2]H_2$  is obtained. If, however, the solution is faintly acid and the uranyl salt is in considerable excess, a yellow, crystalline compound of the type  $\begin{bmatrix} \text{UO}_2 & \text{C}_{10}\text{H}_8\text{O} & \text{C}_{02} \end{bmatrix} H_2$  separates Protocatechrouranates of the form  $[UO_3(C_6H_3O_2\ CO_2)]H_2$  are obtainable similarly.—C. Antonian: The behaviour of arsenic acid with regard to the absorbent power of soil. Arsenic acid behaves similarly to phosphoric acid in relation to absorption by soil, although it is absorbed to a less degree. With reference to the possibility of the interchange of the phosphoric and arsenic anions, experiment shows that PO<sub>4</sub>" is replaced by AsO<sub>4</sub>" in solutions of arsenic acid, but not in those of arsenates -G. Quagliariello and P. De Lucia: Stereoisomeric transformations of glucose by the action of insulin and of muscular tissue. authors' experiments fail to furnish confirmation of Lundsgaard and Holboll's results, which indicated (1) the existence in the internal liquids of normal animals of an unstable form of glucose (neoglucose) having a very low rotatory power, and (2) the formation of this compound in vitro by the simultaneous action of insulin and fresh muscular tissue on dglucose.—G. Bergami: Action of low temperatures on the crystalline lens. When subjected to low temperatures, the crystalline lens of the sheep or ox behaves like dialysed blood-serum, undergoing partial, reversible coagulation and becoming opaque in the central part Ringer's hypertonic solution produces similar opacity, which disappears if the lens is immersed in Ringer's hypotonic solution; the action of the former solution probably consists in dehydration of the lenticular colloids. The simultaneous action of low temperature and of Ringer's hypertonic solution also results in opacity, reversible at room temperature, even in the crystalline lens of the dog, which is rendered opaque neither by cold nor by the hypertonic solution alone.-G. Cotronei Affinities in Petromyzon according to morphological-systematic and ecological characters.—L. Patanè The perintestinal

layer of the meso-intestine of Balanus The peculiar layer of cells, discovered by Monterosso in the meso-intestine of Balanus perforatus (Bruguière) and termed, first, the peritoneal layer, and later the perintestinal layer, occurs also in Balanus porcatus, B trigonus, and B. cburneus These cells always, or almost always, contain parasomes, and exhibit different morphological and structural peculiarities in the different species—Pia Nalli and G Andreoli: Green's formula in the complex field and the extension of Cauchy's theorem to functions of two complex variables

#### SYDNEY.

Linnean Society of New South Wales, Oct 26.—G H. Hardy: Notes on Australian and exotic Sarcophagid flies A detailed study of the male genitalia would enable the large genus Sarcophaga to be divided into groups of naturally allied species. This is done for some Australian and exotic forms, three groups being defined on this principle, namely, the antilopegroup with six species, the misera-group with seventeen, and the peregrina-group with four Two species from Java are described as new.—Miss H. Claire Weekes Placentation and other phenomena in the scincil lizard, Lygosoma (Hinulia) quoyi. An allantoplacenta is described of a type hitherto not recorded for reptiles. The uterine and allantoic capillaries are exposed at the surface of the maternal and feetal tissues respectively, and scattered cells of the chorionic ectoderm are superficially attached to the maternal wall. This type of placentation is fundamentally similar to that of the marsupial, Perameles.

Royal Society of New South Wales, Nov. 2 -A. R. Penfold The essential oils of two species of Bæckea. B. brevifolia is a small leaved plant of about 18 inches in height which yields more than 11 per cent of essential oil consisting of a- and 3-pinene, cineol, and eudesmol. B limifolia is a tall shrub with drooping branches and white flowers, which yields 0.67per cent of essential oil containing  $\alpha$ - and  $\beta$ -pinene, cymene, cineol (18 per cent.), sesquiterpenes, esters, etc. —M. B. Weich: The moisture content of some eucalyptus woods. Moisture determinations were made on four species of Eucalyptus growing near Sydney, namely, E. eugenvoides, E piperita, E. micrantha. and E. Sieberiana, at intervals over a period of some years. The variation in moisture content which occurs in individual trees, between heartwood and sapwood, and in the same species at different periods, appears to be due to physiological and ecological factors affecting the particular tree in question and cannot be correlated with season or rainfall.—G. S. Currey: The cause of blueing in roses The effect is due to lack of tannin in the cell-sap. Some varieties show a greater tendency to blue than others; "Hadley "represents a blueing type, while "Lady Maureen Stewart "very seldom shows this defect Both types contain the same anthocyanin pigment, namely, cyanın, which occurs in the petals as a glucoside; but the latter contains the larger quantity and there appears to be a direct relationship between the quantity of pigment and tannin present.

#### VIENNA.

Academy of Sciences, Oct. 13.—F. Holzi: The alkylisation of molybdeno-hydrocyanic acid. Experiments with dimethyl sulphate and the potassium salt, and with methyl iodide and the silver salt.—E. Gebauer-Fulnegg and E. Petertii. The simultaneous determination of chlorine in the presence of sulphur in organic compounds.—E. Gebauer-Fulnegg · Sulphur containing derivatives of p-dichloro-

benzole.-P Ludwick and R. Scheu. Brittleness and

notch-tenacity.

Oct. 27.-F. W. Palm · Surfaces and curves of equal parallax in photographic surveys —A. Haas The connexion between the theory of relativity and theory of quanta—A. Pongratz: Researches on perylene and its derivatives.—N. Kreidl: Communication of the Radium Institute, No. 210 Applicability of Geiger's point-counter to experiments on atomic disintegration.

Nov. 3.—V. H. Hess. Formation and annihilation of ions in the atmosphere above the sea and in the mountains. Schweidler's method, using a cylindrical condenser, has been improved and used to determine the vanishing constant of the light ions and its reciprocal, their mean duration of life.—R Muller, V. Raschka, and M. Wittmann: Electrochemistry of non-aqueous solutions (8). Conductivity measurements in dilute solutions of silver nitrate, silver rhodanide, and silver bromide.—E. Gebauer-Fulnegg and E. Riesz: The oxidation process in aryl-sulphuranilides.-C. A. Bobies: The tertiary formations of the basin of Gaaden.

#### Official Publications Received.

Scottish Marine Biological Association Annual Report 1926-27. Pp. 23

Scottish Marine Biological Association Annual Report 1926-27. Pp. 23 (Millport. Marine Biological Station)

Apia Observatory, Samoa. Summary of Magnetic Observations, 1912-20 Pp 40 (Wellington, N.Z. W. A. G. Skinner)

Proceedings of the Royal Society of Edunburgh, Session 1926-1927 Vol 47, Part 3, No. 23 On the Discharge of a Condenser through a Gas at Low Pressure. By W. G. Thomson. Pp. 302-306+1 plate. 9d. Vol. 47, Part 3, No. 24 'The Grasp of Mind on Nature. By Sir Joseph Larmor. Pp. 307-325. 1s. 6d. (Edunburgh. Robert Grant and Son; London Williams and Norgate, Ltd.)

The Imperial College of Tropical Agriculture. Prospectus for 1928-29, also Principal's Report for 1926-27, and Register. Pp. 34+2 plates (St. Augustine, Trimdad, B.W. I.; London. 14 Trinity Square)

Department of the Interior, Canada. Dominion Water Powers and Reclamation Service. Water Resources Paper No. 60 Water Powers of Canada. Pp. 94 (Ottawa: F. A. Acland)

New Zealand. Department of Lands and Survey. Scenery-Preservation Report for the year ended 31st March 1927, together with Statement of Accounts and Schedule of Lands acquired and reserved during the Year under the Scenery Preservation Act. Pp. 11. (Wellington, N.Z. W. A. G. Skinner.) 6d.

Journal of the Indian Institute of Science. Vol. 10B, Part 3. Intensity Variations of Madras (Port) Radio Station. By K. Sreenivasan. Pp. 35-42+3 plates. 8 annas. Vol. 10B, Part 4. Suspension Insulator Testing By G. Yoganandam. Pp. 43-49+1 plate. 8 annas. (Bangalore) Report of the Royal Commission on Land Dramage in England and Wales. (Cmd. 2993.) Pp. 60 (London. H.M. Stationery Office.) 1s. 3d. net.

The Scottish Forestry Journal. being the Transactions of the Royal Scottish Arboicultural Society. Vol. 41, Part 2, October. Pp. 105-336+41-48. (Edinburgh Douglas and Foulls.) 3s.

Proceedings of the Liverpool Geological Society. Session the Sixty-eighth, 1926-1927. Edited by C. B. Travis. Pp. xvii + 285-350. (Liverpool.) 54

#### Diary of Societies.

#### MONDAY, JANUARY 2.

MONDAY, JANUARY 2.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 330.—Dr. E. H. Marshall The Royal Research Ship Discovery in the Antarche (Christmas Lectures for Young People) (1.).

VICTORIA INSTITUTE (at Central Hall, Westminster), at 4.30 —Rev. Dr. P. P. Flournoy: Christ and the Scriptures—What may we gather from His Athitude and Instruction? (Gunning Prize Essay, 1927).

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (in Botanical Theatre, University College), at 5.30.—Dr. D. Forsyth Those First Five Years.

Institution of Automobile Engineers (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—E. A. Watson: The Electrical Characteristics of Spark Gap and Sparking Plugs.

Society of Chemical Industry (London Section) (at Chemical Society), at 8.—Dr. J. C. Drummond. The Future of Biochemical Research.

#### F TUESDAY, JANUARY 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. E. N. da C. Andrade Engines: Engines which work to and fro (Juvenile Christmas Lectures) (III).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBULLDERS (Middlesbrough Branch) (at Middlesbrough), at 7.30.

INSTITUTION OF AUTOWOBILE ENLINEERS (at Royal Society of Arts), at 7.45.—R. F. Engelbach Some Notes on Reorganising a Works to increase Production.

No. 3035, Vol. 120]

ROYAL ANTHROPOLOGICAL INSTITUTE, at 830 — Capt. T A. Joyce Further Researches at Lubamtun, 1927

#### WEDNESDAY, JANUARY 4

ROYAL SOCIETY OF ARTS, at ) -Prof A. Smithells Flame (Dr Mann

ROYAL SOCIETY OF ARIS, at 1—Prof. A. Smithells. Flame (Dr. Mann-Juvenile Lecture) (I.)

INSTITCTION OF ELECTRICAL ENGINERS (Wireless Section), at 6 - T. H. Gill and N. F. S. Hecht. Rotating Loop Radio Triansmitters and their Application to Direction-Inding and Navigation - Dr. R. L. Smith-Rose and S. R. Chapman. Some Experiments on the Application of the Rotating Beacon Transmitter to Matine Navigation —Dr. R. L. Smith-Rose. A. Theoretical Discussion of Various Possible Aerial

Smith-Rose A Theoretical Discussion of Valious Possiole Aerial Altrangements for Rotating Beacon Transmitters.

Instruction of Civil Engineers (Manchester and District Association) (at 36 George Street, Manchester), at 645 – J S Glen Primiose Fatigue and Wear Testing of Materiels.

Instruction of Heating and Ventilating Engineers (at Caxton Hall), at 7 – G U Morgan Oil Fuel Burning for Central Heating and Deducate Rules. Domestic Builers

ROYAL MICROSCOPICAL SOCIETY (Biological Section)

#### THURSDAY, JANUARY 5

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 - Prof E N da C Andiade Engines Engines which work Round and Round (Juvenile Christma

LINNEAN SOCIETY OF LONDON, at 5:30 -Dr Suzanne Leclercq and M Belliere Psygmophyllum Gilkaneti, nov sp from the Middle Devonian of Malonne, Belgium -Prof S II Williams A Naturalist in the

or Maionne, Beigium —Prof S II Williams A Naturalist in the Guiana Jungles, INSTITUTION OF ELECTRICAL ENGINEERS, at 6 — E C McKinnon: Storage Batteries in relation to Modern Supply of Electric Lighting and Power INSTITUTION

and Power
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6:30—
A Fage Some Recent Experiments on Fluid Motion
INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch) (jointly
with Manchester Association of Engineers)—E. G. Herbett Cutting
Temperatures Their Effect on Tools and on Materials subjected

#### FRIDAY, JANUARY 6.

ROYAL GEOGRAPHICAL SOCIETY (at Æohan Hall), at 3.30.—C F Rey: Abyssinia and the Blue Nile (Christmas Lectures for Young People) (II)

Institution of Mechanical Engineers, at 6.—Prof. C. J. Hawkes:

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. C. J. Hawkes: The Marine Oil-Engine (Thomas Lowe Gray Lecture)

Society of Chemical Industry (Manchester Section, jointly with Textile Institute) (at Engineers Club, Manchester), at 7—F. C. Wood and Agnes C. Alexander. The Action of Caustic Alkali on Partially-Methylated Cellulose—The Heat of Reaction and Absorption

ROYAL Photographic Society of Great Britain (Pictorial Group, Informal Medium), at 7.

Informal Meeting), at 7

Informal Meeting), at 7
Geologists' Association (at University College), at 7:30 — Dr. A.
Brammall Dartmoor Detritals' A Contribution to the Study of
Provenance—A W Groves Eccene and Phocene Outliers between
Chipstead and Headley, Surrey — To be taken as read.— F T Ingham:
The Petrology of the Spilsby Sandstone.

#### SATURDAY, JANUARY 7

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 — Prof. E. N. da C. Andrade: Engines: Putting the Furnace in the Cylinder (Juvenile Christmas Lectures) (V).

#### CONFERENCE.

#### JANUARY 3 AND 4.

INCORPORATED ASSOCIATION OF HEAD MASTERS (in the Guildhall, E.C.).

Tuesday, Jun 3

At 10 55 — G Smith President's Inaugural Address.

At 2 15 — What Commerce and Industry ask of Secondary Schools

R F Cholmeley and others: What Secondary Schools ask of Commerce and Industry.

Educational Experiments (a) H. W Cousins Th

(a) H. W Cousins The School Curriculum in relation to Environment: an Account of an Experiment at Biampton County Secondary

(b) A Lyon Musical Adventure in a Secondary School.

Wednesday, Jan 4 At 11 15 — Wickham Steed: The Position of German in English Secondary Schools

C H Lockitt and others: The Disabilities of Secondary School Pupils

m Rural Areas.
At 2 15 -C. H K, Marten: The Teaching of History in Secondary Schools

H Cladock-Watson Bible Teaching in Secondary Schools. Discussion on The Provision of Books and School Apparatus.

#### EXHIBITIONS.

#### JANUARY 6.

JUNIOR INSTITUTION OF ENGINEERS, at 6 -Exhibition of Instruments and Scientific Appliances.

#### JANUARY 10, 11, AND 12.

ANNUAL EXHIBITION OF THE PHYSICAL SOCIETY AND THE OPTICAL SOCIETY (at Imperial College of Science and Technology), from 3 to 6 and from 7 to 10.—Discourses at 8.—

Jan. 10 .- A Whitaker . Progress in the Recording and Reproduction of

Sound.

Jan. 11 -V. E. A. Pullin Recent Application of X-Rays.

Jan. 12 -Dr. J W T. Walsh: Artificial Daylight.

# Supplement to Nature

No. 3009 JULY 2, 1927

#### Life and Death.

THE ages of the Jewish patriarchs as recorded in the Old Testament have provoked much discussion and speculation. Has the span of life decreased during the passage of the centuries? Census statistics show, at any rate in Great Britain, that the expectation of life at birth has increased considerably in recent years. This, however, does not necessarily mean increased longevity, and investigations on remains of men of periods about two thousand years ago suggest that the expectation of life in advanced ages has actually decreased. The men who survived in those days were necessarily of strong constitutions

To those who may have hoped that science will soon provide the means whereby the span of human life may be prolonged, the critical consideration of the factors concerned in the onset of old age given by Sir Humphry Rolleston in the following pages will show that such hope is as yet vain. This does not necessarily imply, however, that the declining years of life cannot, in certain cases, be rendered less irksome.

As is well known, certain primitive organisms, such as Paramocium, may be described as im-Why then are multicellular animals mortal? The mutual influence of the cells of the body upon one another appears to be the basis both for the rise of the multicellular animals in the scale of life and also for their mortality In artificial cultures certain of the cells of the higher organisms can live and multiply indefinitely, provided that they are supplied with suitable nutriment and their waste products removed. But if the latter accumulate to any extent they exert an inhibitory action on the life and reproductive power of the cells: it appears possible, then, that some similar process may account for the gradual decay of the body's cells in old age

On the other hand, one of the most important, if not the dominant factor, in determining the span of life, is inheritance, and this is acted on by the other factors, the sum of which forms the environment in its broadest sense. A favour-

able environment is produced by healthy living, especially the avoidance of excesses of every kind. and in such a case a very fair degree of mental and physical vigour may be retained even to the last. But few people escape lesions, produced by some kind of infection during the course of their life and tending to shorten it. Are there any means by which the span of life may be prolonged or old age rendered less irksome, by which, in fact, the body may be 'rejuvenated'?

On the hypothesis that old age is largely caused by the decay of those cells in the sexual glands which are responsible for the onset of puberty and the development of the secondary sex characters of the individual, Steinach and Voronoff have devised operations to increase the activity of these cells and thus postpone the onset of old age. They have claimed that, by stimulating the individual's own cells to increased activity or by supplying the necessary secretions from foreign cells introduced into the body by grafting, they have been enabled to prolong life and postpone senility in both animals and men. In so far as the symptoms of old age are due to the decrease in the secretions of these glands, it should be possible to relieve them by increasing the supply of these secretions, but to assume that the decrease in the latter plays the sole, or even the major part in the onset of old age, appears to be to take too narrow a view, considering the mutual influence which the cells of the body are known to exert upon one another.

There appears, then, to be no short cut to the abolition of old age and the prolongation of life. Each of us must watch his (or her) step from the day we are born. As Sir Humphry Rolleston expresses it: for a long life there are necessary "a judicious choice of parents, avoidance of disease and worry, moderation in all things, mental and physical exercise, an open-air life, serenity and charity to all men." The prescription seems simple, but the present and coming generations may find it increasingly difficult to carry out under the stress of life under modern conditions.

#### Concerning Old Age.1

By Sir Humphry Rolleston, Bart, KCB

N the simplest forms of animal life—the protozoa—which consist of a single cell, and so stand in the same relation to man that a brick does to a city, multiplication occurs by fission or division into two halves, and as there are now two cells instead of one and no vestige of a corpse, the organism is, as Weismann first insisted, immortal This process may go on indefinitely, and has been watched by Woodruff in Parameeium during 13½ vears, for 8500 generations, comparable to a quarter of a million years of human life, without the occurrence of conjugation—namely, the union of two previously separate organisms, as occurs in the reproduction of higher animals—though periodically rejuvenation appears to take place by means of an independent internal re-organisation (endomixis) of a single cell As the protozoa are, accidents apart, immortal, why is it that animals much higher in the scale never are? It has been shown by culture experiments that the individual cells of man's body are also potentially immortal, but that the necessary conditions for this cannot be realised when they form part of a highly differentiated and specialised complex whole higher walks of the animal kingdom, rejuvenation of the constituent cells is thus rendered much more difficult or impossible, and the process of senescence must be regarded as the penalty for the high degree of individuation entailed in the complicated mechanism of the higher animals and man. But it is interesting to recall that in the humble planarian flat worms the life cycle may be dramatically changed: by starvation they not only become smaller, but also their structure becomes simpler, and their life cycle is reversed by the process of dedifferentiation, reduction, or involution. By alternate starving and feeding, these flat worms have been kept stationary, while others passed through nineteen generations (C. M. Child), thus showing that the duration of existence of cells is not so much a matter of time as of the work or metabolic changes that go on inside them, although it may well be said that such a prolonged existence is not ' life ' according to some views.

Although it is a far cry from amœbæ and flat worms to man, these biological results may have some remote bearing on the conditions influencing the duration of man's life. Not only diet—overand under-feeding, the effects of gross feeding being obviously harmful—but also the more mysterious

influence of the internal secretions provided by the ductless or endocrine glands, the thyroid, pituitary, and the gonads, the activities of which may well be modified by diet, must be taken into account. Disturbance of the endocrine balance, or the equilibrium normally maintained between the hormones or chemical messengers of these endocrine glands, has well-recognised effects on growth and metabolism, and so may influence the rate at which the body lives and wears or rusts out. The significance of the much-discussed 'rejuvenation' produced by Steinach's and Voronoff's operations on the sexual organs proves at any rate that there is much to learn, especially whether or not the duration of life is really prolonged thereby.

#### BIBLICAL AGES

The length of days ascribed to Methuselah (969), to Adam (930, or if the "concert urged by learned men," as Sir Thomas Browne says, that he was 50 or 60 years old when called into being be accepted, making him 980 years at death), to Jared (962), to Seth (912), and others, has of course always excited curiosity. In "Arbor Vitae, or a Physical Account of the Tree of Life in the Garden of Eden," "translated out of the Latine of E M Arrais, M.D., Physician to John the IV King of Portugal, by Richard Browne in" 1683, there is a discussion as to the influence of the emanations of the Tree of Life, the eating of which and the resulting immortality were prevented by cherubims and a flaming sword turning every way, in endowing our first parents and their descendants with longevity, and the conclusion is reached that their length of life was due to the virtues diffused in the air, not only of Eden but also of the neighbouring countries, given off by fruit trees other than the Tree of Life in the Garden of Eden. The longevity of the patriarchs has called forth critical attempts at explanations on the basis of a difference in chronology. But though interesting and perhaps ingenious they are not very convincing, the suggestion that the reputed 'years' were lunar, not solar, containing thirty and not three hundred and sixty-five days, is too radical, for some of the patriarchs would on this interpretation have begotten children before they were ten years of age. The view that the year consisted of three instead of twelve months up to the time of Abraham, when it was extended up to eight months until the time of Joseph, when it first became our full complement of twelve

<sup>&</sup>lt;sup>1</sup> Discourse delivered at the Royal Institution on Friday, May 13.

months, would make Methuselah's age 243 years, which is still excessive by modern standards. The probable explanation is that the patriarchal ages, like those of the mythical golden age of pre-history, existed solely in the minds of later scribes only too anxious to magnify the fathers of mankind. Antediluvian chronology may perhaps be compared with that of the Purānas, or the common scriptures of the ruling Aryan peoples of northern and western India, which contain fragments of truth and much that is imaginary, including in the last category the chronology (Rapson <sup>2</sup>)

The natural or physiological life of man has been thought to be a multiple of the period of growth. Hufeland, taking twenty-five years as the end of adolescence, and accepting Francis Bacon's view that animals live eight times as long as they take to come to maturity, optimistically arrived at two hundred years as the span of man's days on earth, Buffon multiplied fourteen, the age of puberty, by seven, and so concluded that a hundred years was the appointed time. Flourens, on rather different grounds, came to the same estimate, as did the often-quoted centenarian Luigi Cornaro, of Venice (1467–1566), and in more modern times Metchnikoff and Luciani. The number of reputed centenarians, especially in Russia (1 in 1000), Bulgaria (1 in 2000), California (1 in 10,000), and in Ireland (1 in 14,300), is at first sight imposing, but has been sternly discounted and cut down by George Cornewall Lewis, W J. Thoms, and especially by T. E. Young's accurate investigations, and shown, contrary to the general view and other statistics, to be extremely small. Thus we must regard as fabulous the famous examples of Henry Jenkins, Thomas Parr, Katherine, Countess of Desmond, and probably other records, such as the Indian, quoted by Arrais on the authority of many Portuguese Indian governors, who lived more that 335 years, and the truthful tombstone in Carmarthen recording the death in 1831 of Ann David, aged 181 years.

Since the middle of the last century the great reforms in hygiene and sanitation in Great Britain prevented illness and premature death to such an extent that the expectation of life at birth has increased from 39 91 years in 1854 to 51·5 years in 1912 for males, and from 41·9 to 55·35 years for females. These official figures have been kindly given me by Dr T H. C. Stevenson, of the General Register Office, who tells me that provisional rough tables based on the 1921 census and recently published, but not official, show a further increased

expectation of life. This increased expectation of life at birth is due to the prevention of death in early life, and is therefore very different from an increase in longevity. In fact, the statistical conclusion from investigations of the ages recorded on mummies in Egypt two thousand years ago by Karl Pearson, and others quoted by Raymond Pearl, is that the expectation of life at advanced periods has declined. Karl Pearson in 1902 found that, though a man of twenty-five lives on an average fifteen years more than one two thousand years ago, the expectation of life after the age of sixtyeight for a Romano-Egyptian two thousand years ago was greater than for an English man or woman of the same age, and pointed out that with these ancient people at about the beginning of the Christian era it was a case of the survival of the fittest, whereas the difference in the expectation of life at earlier ages is evidence of the great social and sanitary progress that has conquered environment:

While the Psalmist's estimate that "The days of our age are threescore years and ten; though men be so strong that they come to four score years, yet is their strength then but labour and sorrow," is still the common experience, there are of course exceptions that we can all point In his prize essay on comparative longevity written in 1870, Sir Ray Lankester compared persons of abnormal longevity with giants in height which might range up to nine feet; but it is now known that these giants are morbid and examples of acromegaly, described by Pierre Marie in 1886, and it would be curious seriously to regard extreme longevity as a disease, as it is so obviously favoured by absence of that state. On balance, it may be still thought that the physiological age of man is a hundred years, though few there be that reach it. Women live longer than men; and among reputed centenarians also the ratio is much in favour of that popularly said to be the weaker sex; out of 691 reputed centenarian deaths during the ten years 1910-19 inclusive, 504, or 73 per cent., were females, and 187, or 27 per cent., males. 1923 the numbers were 74 females and 22 males.

The reason for the limitation of life, in other words death, has naturally been much debated. Weismann suggested the thesis—a perverse extension of the theory of natural selection and survival of the fittest—that death was an adaptation advantageous to the race Death, which has thus been evolved in the process of advance from a protozoan to the higher metazoan standard of existence, might be regarded as a provision against over-population and famine from insufficiency of

 $<sup>^2</sup>$  Rapson, E. J., in the "Cambridge History of India," 1922, vol. 1, p.  $305\,$ 

the food supplies of the world, and so the natural counterpart to modern artificial birth control Miles Symner, professor of mathematics in Trunty College, Dublin, in the seventeenth century, calculated that in the 1400 years between the Creation and the Flood there would not have been standing room on the earth's surface if the patriarchs, with an average breeding period of four hundred years, begat a son every three years With the present rapid increase of the world's population, thanks to improved sanitation, there have not been wanting estimations that, should no change occur, a few centuries will show the food supply of the world inadequate for its inhabitants (Raymond Pearl, Ravenel)<sup>3</sup>

Metchnikoff considered death to be the result of intoxication from bacterial activity in the alimentary canal, and it has by many been ascribed to arterial disease; the latter is no doubt a common cause of death, but not of the physiological termination of life. But a more satisfactory conception is an inherent constitution determined by heredity, the constituent cells being thus endowed with a certain store of vitality for themselves and their descendants, and that as this runs out the process of involution begins. Cell culture observations, however, suggest that there gradually develops in the cells a substance which inhibits their vitality. Carrel and Ebeling 4 found in cultures of fibroblasts the rate of multiplication and life in vitro varied in inverse ratio to the age of the fowl from which the blood plasma, used in the culture, was taken. It was also found that, with frequent washings to remove waste products, tissue cells can be cultivated indefinitely for years in vitro and have an unlimited capacity for multiplication (Carrel, Champy, and Grandcourt). It would thus appear that there is in old organisms a substance produced in the ageing cells which, entering the blood, exerts an inhibitory action on the life and reproductive power of the tissue cells. On the other hand, Raymond Pearl avoids the assumption of an inhibitory senescent substance in the blood plasma by the simple suggestion that the blood plasma of old animals is itself senescent, and so not such a good culture medium as the blood plasma of the young.

#### \* FACTORS INFLUENCING LONGEVITY.

Experience and that pure and reformed summary of it known as statistics show, as Karl Pearson and A. Graham Bell's figures prove, that inheritance is one of the strongest factors, if not the dominant one, in determining the span of life. The other factors are extrinsic and may be included under the heading of environment in its broadest sense, if we may now use a word which in 1835 John Sterling, in reproaching Carlyle for so doing, described as "barbarous" and "without authority"

Numerous examples of families with long- or with short-lived tendencies will occur to every one, but what heredity can do is perhaps more convincingly established by Raymond Pearl's striking table, from Bell's analysis of the Hyde family, showing the influence of parental ages on that of the offspring: among 184 persons whose parents both hved more than 80 years the average age at death was 52.7 years, whereas among 128 persons whose parents died before 60 years of age their average life was 32.8 years, or nearly 20 years less Forsyth's investigation, carried out on strict actuarial principles, shows that if the reasonably preventable diseases be eliminated, the expectation of life, though increased, would not be so much prolonged as by the influence of a long-lived heritage. We should, therefore, both in our own and their interests, counsel our children to choose their parents carefully As Benjamin Ward Richardson pointed out, the combined ages of one's parents and grandparents divided by six may be of assistance in numbering our days.

A sound stock may overcome the evil influence of environment, such as alcoholism and unhealthy surroundings in towns, and thus explain the occasional longevity of those whose lives have been far from blameless, and the contrast between two aged brothers, one sober, the other intemperate. But even with a poor inheritance care may extend the term of a useful and happy life. Sir Hermann Weber, by practising the precepts of his book on "The Prolongation of Life," led an active and happy existence until within a short time of his death at ninety-five, although his parents died at or before sixty years of age of heart failure and cerebral hæmorrhage—conditions due to high blood pressure and arterio-sclerosis

Of the hereditary factors, inherent vitality of the nervous and the vascular systems are the most important; the force of the nervous tissues calls the tune both in the mental disposition and the physical reactions of the body. As the late Sir William Osler remarked, much depends "on the quality of arterial tissue (vital rubber) which the individual has inherited." This statement, it may incidentally be mentioned, provides the answer to the question,

<sup>&</sup>lt;sup>3</sup> Ravenel, M. P., The Gordon Bell Memorial Lecture, 1925, on "The Prolongation of Life To what Goal is it Tending?" Am. Jour. Public Health, New York, xvi. supplement to February number Carrel and Ebeling, Jour. Exper. Med., Baltimore, 34, 599, 1921.

"What internal evidence is there that Osler has had an unhappy experience with cheap bicycles?" set in an examination paper, analogous to Calverley's famous examination paper on "The Posthumous Papers of the Pickwick Club," on his textbook of medicine. Cazalis' aphorism, "Man is as old as his arteries," is true in so far as the state of the vessels is in certain respects a good index of his prospects, for their condition may be largely determined by heredity, or deteriorated by disease or undue strain, and so provides a record of his family history and personal adventures, but the converse, "the arteries are as old as the man," would not hold good, for arteriosclerosis is not necessarily well marked in very old people

Bodily Conformation.—The long-lived are usually spare and very seldom fat, neither very tall nor very short, very heavy, nor very light Insurance companies are naturally much interested in the bearing of the body-build on longevity, and in America much statistical investigation has been started into problems such as the bearing in persons above the average weight, of the length of the spine, and a comparison of the chest and abdominal girths. From the insurance companies' statistics Dublin <sup>5</sup> found the following rather surprising and confusing results:—Among those over the average weight the prospect of life was better among short and medium height men with short relative spinelengths and with chest girths below the average, and among overweight tall men the outlook was best in those with long relative spine-lengths and chest girths below the average. So that in both of these groups of men above the average weight the presence of a chest measurement below the average was an asset.

Taking environment in its widest sense, the influence of disease in damaging the tissue cells and in accelerating degeneration and atrophic processes resembling those which normally occur must be given due weight. It has been said that only those who have kept their bodies free from disease up to the age of 60 can expect to attain extreme old age (Saundby); but nearly half of the 824 persons between the ages of 80 and 100, analysed by Sir George Humphry, had passed through a severe illness, many of them acute infections It seems highly probable, however, that the influence of an acute illness, the resulting changes being often transient and recoverable, would be much less harmful than that of a long-continued infection or intoxication in producing permanent changes.

There are exceptions, and a terribly notable one is encephalitis epidemica, the 'sleepy sickness' of the lay press. Chronic infections, especially those in connexion with the teeth, are prone to cause rheumatoid arthritis, and the resulting limitation of activity does harm both to the general health and also mentally by impressing the idea of future crippling and incapacity. Acute illness may undoubtedly be the apparent starting-point of old age, more particularly if insufficient time, holiday, and change of scene be not allowed for recovery, the time allotted increasing roughly with the nature of the illness and the patient's age The influence of infections, such as malaria, which Dr. W H S. Jones has shown was an important factor in the decadence of Magna Graecia, and of syphilis, both on the collective and individual health and longevity, need not be laboured

The ideal of medicine is the prevention rather than the cure of disease, and for this end the detection of the earliest stages, and better, of the disposing causes of diseases, is essential. Timely warning about diet, exercise, and manner of life may do much to prevent disease from getting a firm seat on a man's back, and it is not without significance that life assurance companies in America have found it pay to provide periodic medical overhauls to their clients.

Functional activity, mental and physical, plays a great part in keeping the body, when free from disease, trim and slim and in postponing the advent of morbid old age. Occupation with a keen desire to carry it through is so beneficial that some, such as Karl Marx, would regard old age as largely a ques-Speaking of the circle in which tion of will power Madame du Deffand moved, Lytton Strachey<sup>6</sup> says. "They refused to grow old, they almost refused to die Time himself seems to have joined their circle, to have been infected with their politeness, and to have absolved them, to the furthest possible point, from the operation of his laws. Voltaire, d'Argental, Moncrif, Henault, Madame d'Egmont, Madame du Deffand herself, all lived to be well over eighty, with the full zest of their activities unimpaired."

Retirement is a problem beset with anxiety and danger, a successful business man when relieved of routine and able to indulge in idle luxury and without hobbies may rapidly degenerate. He now has to find occupation to kill time instead of time to do all he must; he begins to feel that 'his day is done,' that he has little but his dinner to look forward to, and that at last he is old and a 'has been.'

<sup>&</sup>lt;sup>5</sup> Dublin, L. I., De Lamar Lectures, 1925-1926, p 113

<sup>6 &</sup>quot; Books and Characters," p 83, London, 1922

Thus auto-suggestion, even if not helped by suggestion from outside, hurries him on the downward path, any trifling ailment, such as rheumatism or indigestion due to overfeeding, may arouse very hypochondriacal anticipations, and observation of contemporaries with premature senile changes may feed the flame of this destruc-There is, therefore, a basis tive auto-suggestion for the idea that senility is catching, and for seeking the companionship of the young and thereby letting auto-suggestion work in a constructive direction A well-occupied mind, a happy disposition that thinketh no evil, naturally smiles instead of frowning on a stranger or a new idea, free from anger, hatred, and jealousy, the vice that gives no pleasure to any one, and an attitude of charity in its original and best sense to all, tend to prolong life and make it a happy, healthy prelude to crossing the bar Sir James Crichton-Browne's words, "the best antidote against senile decay is an active interest in human affairs, and those keep young longest who love most."

As showing the influence of long-continued active work, reference may be made to the longevity of dignitaries of the church and the bench, and Prime Ministers, though these are no doubt supermen Among painters there are some examples of very long lives fully occupied up to almost the end— Giovanni Bellini, Michelangelo, Sidney Cooper, Luke Fildes; Titian, for example, was painting with "incomparable steadiness of hand" when cut off by the plague at ninety-nine. Public duties may provide a means of useful and health-maintaining activity; thus during recent years there have been two octogenarian Lord Mayors of London, Sir Thomas Crosby (1911) and Sir John James Baddeley (1921). Compulsory retirement on attaining an age limit in the civil and military services, and now at the older universities, may not always be in the best interests of the individual or of the community; but as the majority of septuagenarians suffer in greater or less degree from pathological old age, it is a good general rule; and those who fall under the axe may comfort themselves on escaping the danger of epitaphs, which add another terror to death, like that bestowed in the "Reminiscences of the University, Town, and County of Cambridge," begun by Henry Gunning when he was over eighty, to the effect that "Professor Edward Christian died in 1823 in the full vigour of his incapacity."

Food.—Experience, ancient and modern, both lay, such as is set forth in Cornaro's "Discourses on a Sober and Temperate Life" (1558), and

medical, as contained in the works of the great George Chevne (who at one time weighed 32 stone before he became a vegetarian), author of "An Essay of Health and Long Life" (1724), Metchnikoff, Henry Thompson the surgeon, and Hermann Weber the physician, agree on the importance of moderation in food. Most centenarians have been small eaters, especially of meat, and there is this advantage in poverty and living on Abernethy's earned sixpence a day, or its present-day equiva-Excess of food, though more gradual in its evil influence, is more generally destructive than alcoholism, and there is much wisdom in Montaigne's dictum, "Man does not die, he kills himself," and in the more dramatic proverb, "You dig your grave with your teeth" As already mentioned, in some lowly forms of life, such as planarian worms, partial starvation prolongs life, and there have not been wanting 'cures' on such economical lines. A simple diet throughout life, and, after growth is completed, obedience to the rule of ceasing to eat before a feeling of repletion cries, 'Hold, enough,' can be confidently recommended.

The influence of alcoholic drinks has been much discussed, and here, as in most problems, the influence of personal predilections may unconsciously tinge our conclusions. But there seems no doubt from collective investigations, such as Sir George Humphry inspired, and insurance companies provide, that hard drinkers are exceptional among the long-lived, and that among the characteristics of those who attain great length of days temperance finds a place. But in spite of the opinion of some enthusiasts that the choice of total abstinence is the only sure path to longevity, the recent investigation, undertaken with all a modern statistician's precautions against fallacies, by Prof. Raymond Pearl 7 on more than 5000 individuals at Baltimore, gives the perhaps not unwelcome verdict that "a moderate use of alcohol does not tend to shorten life." Such an opinion, based on sound data, is of unquestionable value, and this I gladly admit, for my impression was that longcontinued and constant absorption of alcoholic drinks, though always moderate and never amounting to intoxication, did tend to age the conscientious devotee, but a few positive instances are apt to make an undue impression. What constitutes a 'moderate use' is open to the criticism brought by Sir Hermann Weber,8 that what may be so for

 $<sup>^7</sup>$  Pearl, R , "Alcohol and Longevity," 1926 , and leading article,  $Brtt.\ Med\ Jour.,\ 1927,\ 1\ 528$  Weber, Hermann, "On Means for the Prolongation of Life," p. 119, 1908.

one is excess for another, and the proverb, "Wine is the milk of old people," has been countered, as is the habit of proverb quoters, with "Vinum lac veneris," and the danger of exposure to other risks. In forming a conclusion in any given case about the question, to drink or not to drink, the personal equation of the individual must weigh heavily. No doubt total abstinence may suit some better and some worse, and while it certainly eliminates the problem of what is moderate, it equally deprives the aged of the help and comfort that some undoubtedly thus receive

Smoking is on rather a different footing from excessive eating and drinking, as Calverley said, "Stories, I know, are told not to thy credit," but whatever may be true of the effects of the injection of nicotine into cats and rabbits, tobacco smoking has not been proved to cause arterio-sclerosis in As Sir Clifford Allbutt, a non-smoker and with a peculiar susceptibility to tobacco smoke, pointed out, if in any way it does cause arterial disease, the process is so slow, at any rate in most people, that its effects become so mingled with other manifestations of old age as to be almost impossible to discriminate, further, as Ruffer<sup>9</sup> proved by examination of mummies, the ancient Egyptians (1580 BC.-AD 525) certainly had arterio-sclerosis without the consolations of tobacco. There is no doubt that the tolerance to tobacco painfully acquired in youth commonly diminishes with advancing years, and that unpleasant symptoms ranging from irregularity of the heart, abdominal pain to tobacco angina may be the means of transforming a previously inveterate smoker into a total abstainer. Sir George Humphry,10 also a non-smoker, specially investigated the habits in this respect of centenarians, among 19 men, 8 smoked much, 1 a little, 10 not at all, of 30 female centenarians, 4 smoked much, 2 moderately, and 24 not at all It is possible that, as in many people it diminishes appetite. smoking may exert a beneficial influence by preventing over-eating.

There are statistics to show that people in the country live longer than those in towns.

The advice then to give others, and even to practise ourselves, should include a judicious choice of parents, avoidance of disease and worry, moderation in all things, mental and physical exercise, an open-air life, serenity and charity to all men. Leonard Williams's epigrammatic summary is

easier to remember "Fresh air, meagre food, freedom from care"

The onset of what is popularly called old age varies in different countries. for example, the wheels of life run much faster in tropical countries, such as India, than in temperate latitudes In the same race there is considerable variation. one man at sixty is prematurely senile—the subject of pathological old age—whereas another aged eighty is vigorous in body and alert in mind. In women the menopause is a milestone, and at any rate is the frontier of the territory of old age. There has been said to be a similar chimacteric in man at fifty or sixty, due to changes in the reproductive organs, but without, I believe, any solid foundation. it may be a survival of the ancient conception of the grand climacterics at 49 (a multiple of the number 7), at 63 (7 multiplied by the magical number 9 of the Arabians), and at 81 Sir Henry Holland in 1873 described the "climacteric disease," which admittedly seldom came on without some previous event, such as cold, gout, a bout of drinking, recent marriage, or bereavement There can be no possible shadow of doubt that after an illness recovery becomes slower as the years roll by, and that often, especially when the proper period of convalescent repose is abbreviated, the onset of old age is first noticed after an illness; the moral is to hurry slowly after illness, be it influenza, operation, or worse.

A senile climacteric about the latter part of the seventh or eighth decade in man, marking the dividing line between old age and decrepitude, as drawn in Chapt. xii. of Ecclesiastes, has been described by Nascher, but it cannot be regarded as comparable to the menopause in the other sex To put the beginning of old age at fifty or even sixty in man would no doubt raise the protest that it is only the elastic period of middle age. In truth there is so much variation that a rigid date cannot be fixed. In healthy people the advent of old age is so gradual that the individual himself has no suspicion of it, and very likely secretly preens himself on looking ten years younger than his years and his contemporaries, whose changed appearance arouses self-congratulation rather than self-examination. Perhaps the suspicion suddenly breaks upon him by overhearing a chance remark of others, by seeing an unwonted reflection of his figure in a mirror, or by some nice girl offering him her seat in an omnibus. Or a holiday may break to him that he cannot walk as of yore because of undue fatigue, or he is held up by shortness of breath or pain on unwonted exertion.

 $<sup>^9</sup>$  Ruffer, M A , Jour. Path  $\ und\ Bacteriol$  , Cambridge,  $15,\,453$  , 1911  $^{10}$  Humphry, G. M , 'Old Age," pp  $58,\,63$ 

#### THE PHYSIOLOGY OF OLD AGE

While the whole body does not age at the same rate, there is a general and progressive dimmution in functional activity corresponding to the atrophic involution of the cells of the organs and The response to stimuli of all sorts is diminished, and this sluggish reaction contrasts with the ready and comparatively exaggerated response to both normal and pathological stimuli in early life. The popular opinion that age is second childhood may be correct in that there is some resemblance between undeveloped and failing mental and physical powers, but there is an enormous difference between the ever actively moving child and the impassiveness of real old age. This failure of the power of reacting to stimuli is seen in the sense organs, few people over sixty have perfect hearing, although most of us do not know it; and, apart from loss of acuity, they often do not take in general conversation so well as others unless their attention is braced up for the purpose The emotions are less active, the death of friends is less of a grief, and so the individual tends to become isolated and to live more on past than on present-day impressions; hence a well-educated man may become more composed and satisfied, whereas one without intellectual interests may sink into mental torpor, vanity, and egocentricity, with the development of fads about health, undue garrulity, and a confirmed attitude of the laudator temporis acti. In what may be regarded as normal old age psychical activity wanes; new ideas do not bubble up, and when brought to the notice are not impetuously accepted. On the other hand, there is more of the philosophic calm born of what, when twitted with impatience, the young university don dismissed as "that greatly overrated property experience." Forgetfulness first of names, and much later of recent events, and mental fatigue are other evidences of the change. With loss of memory comes the habit of repeating the same story or remark, of mislaying things, and of becoming careless about the external graces.

Statements that the race is all to "the younger generation," and that forty marks the end of useful work in the world, are of course exaggerations, and many examples could be brought forward of masterpieces in art, literature, and science which have come from men much above that age. But taking the average, it must be admitted that the elasticity, imaginative power, and originality of mind that produce works of genius and great advances are seldom found in those who have two

score years and ten to their credit. In the early stage, when a suspicion of the approach of age begins to dawn, there may be defensive action in the apeing of the young, so as to conceal the true age: a man may withdraw the date of his birth from "Who's Who" and other books of reference, and a mother has been known to delay the coming-out of her daughter

While calmer and of more mature judgment as . a rule, many, but perhaps not quite normal, old people become more anxious and apprehensive. like their gait, their will power is hesitant animals the instinct of self-preservation seems to fade, and as their time draws nigh have perhaps, if we could only know, a desire for death, comparable to that for "his brother Sleep", old people, though they often complain of their state, generally have what Matthew Arnold called passionate, absorbing, almost blood-thirsty clinging to life" This, however, is not universal, and shortly before the end often disappears so that death is regarded as a welcome release, as is borne out by the famous William Hunter's last words when only sixty-five, "If I had strength enough to hold a pen, I would write how easy and pleasant a thing it is to die."

Muscular power and ability to walk as far and as fast as of yore diminish; the muscles and the glands of the intestine become sluggish so that constipation results; the diminished secretion of cutaneous perspiration makes the skin dry, and the bodily exchanges, as shown by basal metabolism estimations, are less (Aub and Dubois 11; Legrand 12) But except that the temperature in the axilla is lower than normal on account of the diminished blood supply to the skin, the internal temperature of the body is not, as might be expected, and indeed has been stated, lowered. The explanation appears to be that, although there is less heat produced in the body, there is less loss of heat from the dry skin on account of its poor vascular supply. Diminished sensibility to pain, both mental and bodily, is a beneficial relief, and suggests that with the gradual involution and approach to physiological death this warning will no longer be needed This in some degree accounts for the latency of disease, such as pneumonia, urinary calculi, gallstones, or cancer, sometimes shown by the aged. There are, however, exceptions, such as pain after zona (shingles) and obstinate itching. Sleep is less continuous than in youth, and early waking is common. Recovery from illness

Aub and Dubois, Arch. Int. Med., Chicago, 19, 823, 1917
 Legrand, R., Rev. franç. de l'encrinolog., Paris, 4, 199, 1926.

is slower, wounds and fractures of bones take longer to heal, and intracapsular fracture of the neck of the femur, which is prone to occur from the thinning of the bone and the altered angle at the junction of the shaft and the neck of the bone, is a serious accident, often followed, as if it were the last straw, by dissolution The old react somewhat differently to drugs, responding less promptly, so that some, such as purgatives, may be needed in considerable quantities. On the other hand, tolerance, as to tobacco, may become so much diminished that idiosyncrasies to certain drugs may appear; morphine should be preceded by a previous dose of atropine to protect the senescent respiratory centre from being put to sleep, but the old are scarcely so susceptible as children to this

Though a gradually rising blood pressure is commonly seen to accompany the passing years, a high blood pressure is not a feature of old age; in fact, it might be said that those who attain great length of days do so, in part at least, because they have not had a high blood pressure to wear out and thicken their blood vessels. The pulse often shows intermittence (extrasystoles); this was so in one-fifth of the 824 persons analysed by Sir George Humphry, and though sometimes a cause of annoyance is not of any import.

#### NORMAL STRUCTURAL CHANGES IN OLD AGE.

Just as it may be difficult to state dogmatically that an old person is purely in a state of physiological senescence, as opposed to a condition in which past illnesses and infections have played a part so that there is a combination of physiological and morbid influences—of senescence and senility—so it may be hard to draw a hard-and-fast line between the structural changes of physiological involution and atrophy and those that may be regarded as pathological, especially as disease may accelerate the involutionary changes. It is probable that the ideal of physiological involution is so rare that at best the changes are but relatively physiological. The general atrophy is shown by loss of weight, for how rare it is that a really old person is fat, in fact, obesity is a sign that the normal metabolism, or exchanges in the body, is not physiological. The atrophic process does not proceed equally in all the constituents of the body; the nobler active cells are much more affected than the supporting fibrous tissues. The nerve cells in the brain and spinal cord become small, degenerated, and pigmented, and the brain as a whole weighs less. Arcus senilis, though occasionally seen in early life, is like grey or white hair, an accompaniment of age and due to degeneration, changes in the crystalline lens cause presbyopia, which may be brought on prematurely by toxamia, it is said, of intestinal origin (E. Clarke)

The fall of the hair is not necessarily confined to the aged; a rare, but curious, effect is that after illness naturally brown hair has been reported in place of that previously white. The skin becomes dry, glossy, inelastic like parchment, and wrinkled from atrophy of the fat, muscle, and elastic tissue, especially on the backs of the hands. From diminution of the blood supply there is an ivory pallor somewhat relieved by pigmented areas and dark brown patches of seborrhæic eczema, when in such a condition of impaired resistance the skin readily becomes damaged and is prone to infection, so that pruritus and even indolent ulcers may result. From atrophy of fat the veins become more prominent, and the appearance of small red angiomas on the trunk is common in middle age.

Like the hair, the teeth become few; Sir George Humphry found that above eighty years of age the average number left was six in men and three m women; it may not be so many now. Sir Isaac Newton, however, at the age of eighty-five was said to have lost only one tooth The loss of teeth might perhaps be regarded as a hint that there is no longer need for so much food. With the loss of teeth the lower jaw returns to its shape in the infant, hence the 'nutcracker' aspect of the edentulous face. The bones of the skeleton get thinner, but retain their length and usually their form. The back becomes bowed from muscular weakness, but the cartilages of the ribs and the larvnx do not become calcified except as a pathological event comparable to calcification of the arteries. It is interesting to speculate if there is any relation between the atrophy of bone and the enlargement of the prostate which occurs in a certain number of elderly men; for Grove and Vines found a deficiency of calcium in the blood of patients with enlarged prostates, and obtained benefit by giving extract of parathyroid gland, which controls calcium metabolism

The heart is probably less altered than the other organs and tissues of the body, and indeed its efficiency must be essential for prolonged existence, as may be shown by statistics to the effect that from sixty to ninety years of age death is more often due to failure of the circulatory system, sometimes a blessed painless passing away in sleep, than to any other cause, whereas before sixty, failure of

the respiratory system is most responsible, to keep the heart in a healthy condition exercise is important.

The blood of healthy octogenarians does not necessarily show any change in the number of the red blood corpuscles and the amount of hæmoglobin, though pallor of the skin may suggest an anæmia which does not exist. Sometimes there is secondary anæmia resembling the Addisonian type, this is either due to morbid influences or to a more advanced atrophy and involution of the red bone marrow than usually occurs. The lymphatic glands, the spleen, and the leucoblastic bone marrow all, like the other organs, diminish in size, but this does not appear to influence the leucocyte count.

As already mentioned, arterio-sclerosis is neither the necessary accompaniment nor the cause of healthy old age. But it is very frequent in old people, and often causes premature sensity, renal disease, and difficulty in walking (intermittent claudication or limp)

The endocrine glands share in the general involution, but in spite of attempts to find in them, and especially in the thyroid and the interstitual cells of the gonads, the elixir of life, this desideratum is still to seek

The sexual organs slowly atrophy, with the exception that the prostate gets larger in most men after the age of fifty, though a small percentage only of them suffer from it. The formation of fibro-myomatous tumours of the uterus and of cystic involutionary changes in the mammary glands of women appear to be analogous to that in the prostate

#### HEALTHY AND PATHOLOGICAL OLD AGE.

From the time of Terence, Cicero, and Sanatorius, old age has been regarded as a disease, and Samuel Johnson remarked, "My diseases are an asthma, a dropsy, and, what is less curable, seventyfive." But it is important to remember that there are two kinds of old age: (1) The healthy old age. which I almost called the normal, but perhaps, as this might imply that it is the usual or average form, it is better not so described; and (ii) the commoner, in which the body has not simply grown old, but shows the relics and results of past disease, accumulated in the passage of years. It has been said, and with fair probability, that most people over sixty years of age have some focus of infection, such as those in connexion with the teeth, the accessory nasal sinuses, the prostate, or gall bladder; these sources of poisoning undermine the general health and age the tissues, especially when they are beginning to undergo the natural process of involution and atrophy. To draw a hard-and-fast line between healthy old age (senescence) and old age partially caused by some disease may, in individual instances, be difficult or even impossible, they so often overlap. It is, however, observance of pathological old age that accounts for the pity, if not dislike, with which it is commonly viewed, and for the opinion expressed by many people that they have no wish to live to a great age

The influence of adverse conditions, unhealthy surroundings, infections, and disease in shortening life and producing a pathological, that is, unnatural, old age is seen by comparing the physiological existence of man, which not unreasonably may be put at a hundred years, with the average expectation of life at birth in England and Wales-55 35 years for females and 515 years for males age of fifty to sixty is that when some common diseases, such as arterio-sclerosis, failing heart. kidney disease, cerebral hæmorrhage, liver disease, and cancer, take a heavy toll. Those who survive with cardio-vascular disease are prematurely restricted in their activities and so help to increase the unhappy impression that advancing years has in the popular mind.

There are many definitions of disease, or 'want of ease,' and as good a one as any is a want of adjustment between the individual and his surroundings. The frequency with which those advanced in years suffer pain and discomfort is evidence of more than length of days; for example, rheumatism is the result of some focus of infection. Arterio-sclerosis, the result of past or present high blood pressure or of poisons—bacterial, metabolic, and of intestinal origin—is very common in old people, but is not, at least in an extreme degree, a necessary accompaniment

# THE DESCRIPTION OF OLD AGE IN THE TWELFTH CHAPTER OF ECCLESIASTES.

In connexion with old age, every one must recall the famous description in the first six verses of the twelfth chapter of Ecclesiastes, beginning, "Remember now thy Creator in the days of thy youth, while the evil days come not, nor the years draw nigh, when thou shalt say, I have no pleasure in them." Formerly ascribed to King Solomon (977 B.C.), the Book of Ecclesiastes (in Hebrew Koheleth = the preacher) has been shown by the higher criticism to date only from the end of the third century B.C. In his attractive work, "A

Gentle Cynic," 13 the late Prof. Morris Jastrow, jun, of Philadelphia, argued that the book of Ecclesiastes as it appears in the authorised version, consists of (1) the original, cynical, but good-natured obiter dicta of the unknown dilettante who preferred to veil his identity under the name of Koheleth, and (ii) additions and modifications made by various hands to render it more orthodox and compatible with the tradition that it was written by Solomon Thus the admonition "of making books there is no end; and much study is a weariness of the flesh," may very probably have been intended as a hint that Koheleth's views should not be taken too seriously. Following this conception, Jastrow reconstructed the text of the book of Ecclesiastes to what he argued was its original form, and compared it with the more modern writings of Omar Khavvám and Heinrich Heine. As we all must have speculated over the correct interpretation of the various metaphors in this description of the last stage of life, the explanations offered by others, such as Andreas Laurentius 14 (1599), Master Peter Lowe 15 (1612), founder of the Faculty of Physicians and Surgeons of Glasgow, Bishop J Hall <sup>16</sup> (1633), Richard Mead <sup>17</sup> (1775), and Jastrow may be very briefly mentioned 1666, John Smith devoted a book of 266 pages to elucidate these six verses which contain 207 words -" King Solomon's Portraiture of Old Age wherein is contained A Sacred Anatomy both of Soul and Body" He is peculiar in authorship on this subject at his early age, thirty-five years, for nearly all the other writers on this topic, such as Cornaro, Sir Anthony Carlisle, Charcot, Sir George Humphry, Sir Hermann Weber, and Robert Saundby, not to mention and embarrass those happily with us, have been approaching "the sere, the yellow leaf," and have perhaps been moved to their labours by the maxim, "Physician, cure thyself."

The second verse, "While the sun, or the light, or the moon, or the stars, be not darkened, nor the clouds return after the rain," is regarded by Laurentius, Lowe, and Hall as referring to the ocular disabilities of old age, whereas Smith and Mead consider that mental failure and depression are meant As regards the third verse, "In the

in 1616.

day when the keepers of the house [the hands] shall tremble, and the strong men | the legs | shall bow themselves [become bent], and the grinders [teeth] cease because they are few, and those that look out of the windows [the eyes] be darkened," there is general agreement, Lowe specially designating cataract as meant in the last sentence. "And the doors shall be shut in the streets" is regarded as referring to the mouth by Laurentius and Mead, and to the various orifices, including the resultsconstipation and dysuria—by Smith, "when the sound of grinding is low" is considered by Jastrow to mean impaired hearing, and by Smith as a lowered rate of metabolic processes, such as assimilation, blood formation, and various secretions. "And he shall rise up at the voice of the bird" implies, according to Smith and Mead, the early waking of the elderly, " and all the daughters of musick shall be brought low" signifies to Laurentius the failure of voice, to Mead deafness, and to Smith all the organs concerned with sounds -namely, the lips, tongue, larynx, and the auditory apparatus. "Also when they shall be afraid of that which is high, and fears shall be in the way" is regarded by Smith as describing the general mental attitude of anxiety for things both small and great and a bad head for height, but a more modern commentator suggests that "afraid of that which is high" refers to dyspnæa on climbing a hill. "And the almond tree shall flourish" is by Laurentius, Hall, and Smith thought to refer to the white hair or 'churchyard flowers' of the old, but Mead argued that loss of smell is meant. "And the grasshopper shall be a burden" has been very variously interpreted. Hall is content to accept the literal meaning that the least weight is a nuisance, Laurentius and Lowe understand edema of the legs; John Smith that the aged body undergoes the reverse change of shrivelling, hardening, and angularity. In the sixth verse the words "or ever the silver cord be loosed" refer, according to Laurentius, Lowe, Mead, and Jastrow, to kyphosis, but Smith translates them into paralysis of the spinal cord and nerves. "Or the golden bowl be broken" signifies cardiac failure to Laurentius and Lowe, but cerebral hæmorrhage to Smith, who thus explains the next line, "or the pitcher [the veins] be broken at the fountain [the right ventricle], or the wheel |the arterial circulation] broken at the cistern [the left ventricle]," and therefore concludes that King Solomon was perfectly acquainted with the circulation of the blood discovered by William Harvey

 <sup>13 &</sup>quot;The Gentle Cynic, being a Translation of the Book of Koheleth, commonly known as Ecclesiastes, stripped of later Additions, also its Origin, Growth, and Interpretation," by Moiris Jastrow, junior, 1919, J B Lippincott Co
 14 Laurentius, A, "A Discourse of the Preservation of the Sight, of the Melanchoho Diseases, of the Rheums, and of Old Age" Translated out of French into English by Richard Surphlet, 1599
 15 Lowe, P, "The Whole Course of Chirurgerie," 1612
 16 Hall, J, "Paraphrase upon the Hard Texts of the Whole Divine Scripture," 1633.
 17 Mead, R., "Medica Sacra" Translated from the Latin by Thomas Stark, 1755.

Stark, 1755.

#### DISEASES OF OLD AGE

The diseases of old age would make a long chapter In each of the ages of man's strange eventful history some diseases are particularly prominent, and others very unusual or never occur. but, generally speaking, the influence of age consists in modifying the character rather than in initiating special forms of disease A convenient method of considering the subject would be under the two heads of diseases (1) occurring in the aged, and (ii) those more or less confined to the last phase Diseases common to all or most stages of life are in old age less acute, less dramatic, and more prone to be latent: in Charcot's words, the organs suffer in silence without any local or general disturbance, though sudden collapse may occur. pneumonia, which Osler called "the friend of the aged," because by a short and rarely painful illness it relieves them from those "cold gradations of decay" that make the last stage of all so distressing, is often so latent that death is ascribed to senile decay.

There is, as already pointed out, a great contrast between early and late life in the reaction to disease, but in acute disease, contrary to what might be expected from what has been said about the sluggish response, there is no tendency to absence of fever in the aged. In life's journey the scars and effects of disease accumulate so that rheumatoid arthritis and crippling arteriosclerosis and its results, and some forms of cancer, become more prominent. Dr. T. H. C. Stevenson, of the General Register Office, has kindly provided me with statistics showing that cancer is not a disease of the period from fifty to seventy, rather than of the more advanced old age; in fact, recent returns, with a few apparent and doubtful exceptions, show that, on the whole, mortality from cancer of the more accessible sites continues to increase up to extreme old age, whereas that from the less easily accessible does not, the decrease in extreme old age being greatest for cancer in parts of the body—the stomach and intestmes—where it is more likely to escape detection <sup>18</sup> In America it has been estimated that 10 per cent. of all old people die from unsuspected cancer (Wood <sup>19</sup>). It has, however, been argued that old age alone does not specially favour the development of cancer, and that the relationship is entirely indirect by providing opportunity for long-continued irritation (Murray <sup>20</sup>). In old age repeated exposure to the infections responsible for fevers, such as measles, scarlet, diphtheria, and typhoid, has produced a considerable degree of protection. Pneumonia and erysipelas, however, are prone to recur.

Many of the affections of the old are the result of arterio-sclerosis, a legacy of the middle period of life, which has continued to progress, and by interfering with the circulation produces serious degeneration in the important cells of the organs. especially in the central nervous system, thus from changes in the brain and spinal cord there result senile dementia and various forms of paralysis. and from implication of the arteries of the lower limbs difficulty in walking from cramp and intermittent claudication, and senile gangrene. There is a form of tremor in the elderly which often affects the head, and paralysis agitans or Parkinson's disease—so called after its describer, James Parkinson, a humble general practitioner in Hoxton. who was also a palæontologist and author of pamphlets advocating bloodless revolution—though not confined to old age, is most usual then; it is of particular interest because its features are closely imitated by the result of encephalitis epidemica, which since the War has been comparatively common in the young, and so is a good example of the degenerative effects of disease imitating those seen in advanced age.

Stevenson, T. H. C., "The Registrar-General's Statistical Review of the England and Wales, 1923," text, p. 69
 Wood, F. C., Jour. Am. Med. Assoc., Chicago, 83, 569, 1919.
 Murray, J. A., Eighth Scientif. Rep. Imperial Cancer Res. Fund, p. 79, 1923.

# Supplement to Nature

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#### British Association Addresses.

A Message from H R H. The Prince of Wales, K G , F R S , on Laying Down the Presidency of the Association.  $^1$ 

Association has come to an end, and I can only express my regret to the members of the Association, and to our hosts the City and University of Leeds, that I am unable to attend personally in order to take my leave.

At Oxford last year I ventured in my address to lay before the meeting a view of the relations between science and the State I felt subsequently some justification for having chosen this topic, when I observed in the proceedings of the Imperial and Colonial Conferences of the past year the extraordinary emphasis laid upon the value of scientific research in relation to imperial development Both conferences set up special committees on research, and we cannot but believe and rejoice that the foundations of an imperial scientific service are being firmly laid. The Prime Minister of Australia indicated "the application of science both to our primary and secondary industries" as "the most important thing for Empire trade"; more recently our ex-president, the Earl of Balfour, invited the attention of the House of Lords to "the enormous value of the work given by men of science, with the most lavish generosity," to the study of problems of the common welfare.

Such events as these place it beyond doubt that one of the main objects of the British Association itself is in process of achievement, namely, that of "obtaining more general attention for the objects of science" The Association, the so-called parliament of science, is one of the chief instruments to that end, and I trust that the public support will continue, in increasing measure, to be accorded to its work. Its powers, I am happy to say, have been very materially strengthened, during my own term of office, through the splendid generosity of Sir Alfred Yarrow, in making a gift of £10,000 for the general purposes of the Association, to be expended, in accordance with his wise provision, in the course of twenty years. I gladly take this opportunity of publicly repeating the thanks of the Association to Sir Alfred Yarrow.

In resigning the chair to Sir Arthur Keith, I can whole-heartedly congratulate the Association on its choice of my successor. His name stands very high in the science of man's origin and early biological history I have reason to believe that when, any one in this country digs up a bone his first instinct (subject to the intervention of the police) is to send it to Sir Arthur Keith You are to hear from him an address on Darwinism as it stands to-day-a subject of perennial interest, and more than once one of warm controversy at our own meetings The occasion of the presidential address does not (I am thankful to say) lend itself to controversy, but the warmth I am sure you will supply in your welcome to Sir Arthur Keith, and, meeting as you are in Leeds, that warmth will be increased by the traditional quality of Yorkshire hospitality.

EDWARD P, President.

<sup>&</sup>lt;sup>1</sup> Read at the maugural meeting of the Association in Leeds on Wednesday evening, Aug. 31.

### Darwin's Theory of Man's Descent as it Stands To-day.1

By Prof Sir Arthur Keith, M.D., D.Sc., LL.D., F.R.S.

Y first duty as your president, and it is a very pleasant one, is to send the following message in your name to HRH The Prince of Wales Your Royal Highness,

The British Association for the Advancement of Science, now assembled in Leeds to begin another session, cannot allow your year of office to terminate without offering to you sincere and humble congratulations on the happy results which have attended your presidency A year ago, in the historic city of Oxford, you did British science the signal honour of coming among us as our president, the meeting you then maugurated set a standard which future gatherings will strive to emulate. The inspiring message you then addressed to us, and through us to men of science in every part of the Empire, has already borne fruit We are within sight of a closer union, for which the Association itself has always striven, between men of science overseas and their colleagues at home, in their endeavour to solve problems of Imperial concern. It is too soon as yet to assess the value of the harvest of science planted under your ægis, for the best vintages of science mature slowly, but of this we are certain: the interest Your Royal Highness has taken in the work of this Association will prove a permanent source of encouragement for all who work for the betterment of life through increase of knowledge. To-night we proudly add your presidential banner to those of the great men of science who have presided over this Association since its inception at York ninety-six years ago.

#### SUBJECT OF ADDRESS.

In olden times men kept their calendars by naming each year according to its outstanding event. I have no doubt that in future times the historian of this Association, when he comes to distinguish the presidential year which opened so auspiciously in Oxford twelve months ago, will be moved to revert to this ancient custom and name it the 'Prince's Year.' And I am under no misapprehension as to what will happen when our historian comes to the term which I have now the honour of inaugurating at Leeds; he will immediately relapse to the normal system of numerical notation. Nor will our historian fail to note, should he be moved to contrast the meeting at Oxford with that which now begins at Leeds, that some mis-

chievous sprite seems to have tampered with the affairs of this Association. For how otherwise could he explain the fortune which fell to ancient Oxford, the home of history? To her lot fell a brilliant discourse on the application of science to the betterment of human lives, while Leeds, a city whose life's blood depends on the successful application of science to industry, had to endure, as best she could, a discourse on the theme of ancient history. For the subject of my address is man's remote history. Fifty-five years have come and gone since Charles Darwin wrote a history of man's descent. How does his work stand the test of time? This is the question I propose to discuss in the brief hour at my disposal.

#### THE OPENING SHOT IN THE DARWINIAN BATTLE

In tracing the course of events which led up to our present conception of man's origin, no place could serve as a historical starting-point so well as Leeds In this city was fired the first verbal shot of that long and bitter strife which ended in the overthrow of those who defended the Biblical account of man's creation and in a victory for Darwin. On September 24, 1858—sixty-nme years ago—the British Association assembled in this city, Sir Richard Owen, the first anatomist of his age, stood where I now stand. He had prepared a long address, four times the length of the one I propose to read, and surveyed, as he was well qualified to do, the whole realm of science; but only those parts which concern man's origin require our attention now. He cited evidence which suggested a much earlier date for the appearance of man on earth than was sanctioned by Biblical records, but poured scorn on the idea that man was merely a transmuted ape. He declared to the assembled Association that the differences betwee man and ape were so great that it was necessary, in his opinion, to assign mankind to an altogether separate order in the animal kingdom statement fell from the president's lips there was at least one man in the audience whose spirit of opposition was roused—Thomas Henry Huxley— Owen's young and rising antagonist

#### OWEN AND HUXLEY.

I have picked out Huxley from the audiencer because it is necessary, for the development of my theme, that we should give him our attention for a moment. We know what Huxley's feelings were

 $<sup>^{\</sup>rm 1}$  Presidential address delivered to the British Association at Leeds on Aug  $\,31$ 

towards Owen at the date of the Leeds meeting. Six months before, he had told his sister that "an interneone feud rages between Owen and myself," and on the eve of his departure for Leeds he wrote to Hooker. "The interesting question arises: shall I have a row with the great O there?" I am glad to say the Leeds meeting passed off amicably, but it settled in Huxley's mind what the 'row' was to be about when it came. It was to concern man's rightful position in the scale of living things

#### Man's Position in the Animal Kingdom.

Two years later, in 1860, when the British Association met in Oxford, Owen gave Huxley the In the course of a discusopportunity he desired sion Owen repeated the statement made at Leeds as to man's separate position, claiming that the human brain had certain structural features never seen in the brain of anthropoid apes. Huxley's reply was a brief and emphatic denial with a promise to produce evidence in due course—which was faithfully kept This opening passage at arms between our protagonists was followed two days later by that spectacular fight—the most memorable in the history of our Association—in which the Bishop of Oxford, the representative of Owen and of orthodoxy, left his scalp in Huxley's hands. To make his victory decisive and abiding, Huxley published, early in 1863, "The Evidences of Man's Place in Nature," a book which has a very direct bearing on the subject of my discourse. It settled for all time that man's rightful position is among the Primates, and that as we anatomists weigh evidence, his nearest living kin are the anthropoid apes.

#### OWEN'S OPINION OF DARWINISM

My aim is to make clear the foundations on which rest our present-day conception of man's origin. The address delivered by my predecessor from this chair at the Leeds meeting of 1858 has given me the opportunity of placing Huxley's fundamental conception of man's nature in a historical setting. I must now turn to another issue which Sir Richard Owen merely touched upon, but which is of supreme interest to us now. He spent the summer in London, just as I have done, writing his address for Leeds and keeping an eye on what was happening at scientific meetings In his case something really interesting happened Sir Charles Lyell and Sir Joseph Hooker left with the Linnean Society what appeared to be an ordinary roll of manuscript, but what in reality was a parcel charged with high explosives, prepared by two very innocentlooking men—Alfred Russel Wallace and Charles Darwin. As a matter of honesty it must be admitted that these two men were well aware of the deadly nature of its contents, and knew that if an explosion occurred, man himself, the crown of creation, could not escape its destructive effects. Owen examined the contents of the parcel and came to the conclusion that they were not dangerous; at least, he manifested no sign of alarm in his presidential address. He dismissed both Wallace and Darwin, particularly Darwin, in the briefest of paragraphs, at the same time citing passages from his own work to prove that the conception of natural selection as an evolutionary force was one which he had already recognised

## THE TRANSFORMATION OF OUR OUTLOOK ON MAN'S ORIGIN.

As I address these words to you I cannot help marvelling over the difference between our outlook to-day and that of the audience which Sir Richard Owen had to face in this city sixty-nine years ago The vast assemblage which confronted him was convinced, almost without a dissentient, that man had appeared on earth by a special act of creation, whereas the audience which I have now the honour of addressing, and that larger congregation which the wonders of wireless bring within the reach of my voice, if not convinced Darwinists are yet prepared to believe, when full proofs are forthcoming, that man began his career as a humble primate animal, and has reached his present estate by the action and reaction of biological forces which have been and are ever at work within his body and brain.

#### DARWIN'S GENERALSHIP.

This transformation of outlook on man's origin is one of the marvels of the nineteenth century, and to see how it was effected we must turn our attention for a little while to the village of Down in the Kentish uplands, and note what Charles Darwin was doing on the very day that Sir Richard Owen was delivering his address here in Leeds. He sat in his study struggling with the first chapter of a new book; but no one foresaw, Owen least of all, that the publication of the completed book, "The Origin of Species," fifteen months later (1859), was to effect a sweeping revolution in our way of looking at living things and to initiate a new period in human thought—the Darwinian period—in which we still are Without knowing it, Darwin was a consummate general. He did not launch his first campaign until he had spent twenty-two years in stocking his arsenal with ample stores of tested and assorted fact. Having won territory with "The Origin of Species," he immediately set to work to consolidate his gains by the publication in 1868 of another book, "The Variation of Animals and Plants under Domestication"—a great and valuable treasury of biological observation. Having thus established an advanced base, he moved forwards on his final objective—the problem of human beginnings—by the publication of "The Descent of Man" (1871), and that citadel capitulated to him To make victory doubly certain he issued in the following year—1872—"The Expression of the Emotions in Man and Animals" Many a soldier of truth had attempted this citadel before Darwin's day, but they failed because they had neither his generalship nor his artillery.

#### HISTORY AS WRITTEN BY DARWIN.

Will Darwin's victory endure for all time? Before attempting to answer this question, let us look at what kind of book "The Descent of Man" is. It is a book of history—the history of man, written in a new way—the way discovered by Charles Darwin. Permit me to illustrate the Darwinian way of writing history If a history of the modern bicycle had to be written in the orthodox way, then we should search dated records until every stage was found which linked the two-wheeled hobbyhorse, bestrode by tall-hatted fashionable men at the beginning of the nuneteenth century, to the modern 'jeopardy' which now flashes past us m country lanes But suppose there were no dated records—only a jumble of antiquated machines stored in the cellar of a museum. We should, in this case, have to adopt Darwin's way of writing history. By an exact and systematic comparison of one machine with another we could infer the relationship of one to another and tell the order of their appearance, but as to the date at which each type appeared and the length of time it remained in fashion, we could say very little. It was by adopting this circumstantial method that Darwin succeeded in writing the history of man gathered historical documents from the body and behaviour of man and compared them with observations made on the body and behaviour of every animal which showed the least resemblance to man. He studied all that was known in his day of man's embryological history, and noted resemblances and differences in the corresponding histories of other animals. He took into consideration the manner in which the living tissues of man react to disease, to drugs, and to environment, he had to account for the existence of diverse races of mankind a logical analysis of his facts Darwin reconstructed and wrote a history of man.

DARWIN'S POSITION HAS BECOME IMPREGNABLE.

Fifty-six years have come and gone since that history was written, an enormous body of new evidence has poured in upon us. We are now able to fill in many pages which Darwin had perforce to leave blank, and we have found it necessary to alter details in his narrative, but the fundamentals of Darwin's outline of man's history remain unshaken Nay, so strong has his position become that I am convinced that it never can be shaken

#### THE EVIDENCE OF FOSSIL REMAINS

Why do I say so confidently that Darwin's position has become impregnable? It is because: of what has happened since his death in 1882. Since then we have succeeded in tracing man by means of his fossil remains and by his stone implements backwards in time to the very beginning of that period of the earth's history to which the name Pleistocene is given We thus reach a point in history which is distant from us at least 200,000 years, perhaps three times that amount. Nay, we have gone farther, and traced him into the older and longer period which preceded the Pleistocene the Phocene It was in strata laid down by a stream in Java during the latter part of the Pliocene period that Dr. Eugene Dubois found, ten years after Darwin's death, the fossil remains of that remarkable representative of primitive humanity to which he gave the name Pithecanthropus, or apeman, from Pliocene deposits of East Anglia Mr. Reid Moir has recovered rude stone implements. If Darwin was right, then as we trace man backwards in the scale of time he should become more bestial in form—nearer to the ape That is what we have found. But if we regard Pithecanthropus with his small and simple yet human brain as a fair representative of the men of the Pliocene period, then evolution must have proceeded at an unexpectedly rapid rate to culminate to-day in the higher races of mankind.

# Man's Descent has not been in a Straight Line.

The evidence of man's evolution from an ape-like being, obtained from a study of fossil remains, is definite and irrefutable, but the process has been infinitely more complex than was suspected in Darwin's time. Our older and discarded conception of man's transformation was depicted in that well-known diagram which showed a single file of skeletons, the gibbon at one end and man at the other. In our original simplicity we expected, as we traced man backwards in time, that we should

encounter a graded series of fossil forms—a series which would carry him in a straight line towards an anthropoid ancestor. We should never have made this initial mistake if we had remembered that the guide to the world of the past is the world of the present In our time man is represented not by one but by many and diverse races—black, brown, yellow, and white, some of these are rapidly expanding, others are as rapidly disappearing Our searches have shown that in remote times the world was peopled, sparsely it is true, with races showing even a greater diversity than those of to-day, and that already the same process of replacement was at work. To unravel man's pedigree, we have to thread our way, not along the links of a chain, but through the meshes of a complicated network.

#### THE DIVERSITY OF FORM IN ANCIENT TIMES

We made another mistake Seeing that in our search for man's ancestry we expected to reach an age when the beings we should have to deal with would be simian rather than human, we ought to have marked the conditions which prevail amongst living anthropoid apes. We ought to have been prepared to find, as we approached a distant point in the geological horizon, that the forms encountered would be as widely different as are the gorilla, chimpanzee, and orang, and confined, as these great anthropoids now are, to limited parts of the earth's surface. That is what we are now realising, as we go backwards in time we discover that mankind becomes broken up, not into separate races as in the world of to-day, but into numerous and separate species. When we go into a still more remote past they become so unlike that we have to regard them not as belonging to separate species but different genera It is amongst this welter of extinct fossil forms which strew the ancient world that we have to trace the zigzag line of man's descent. Do you wonder we sometimes falter and follow false clues 2

#### DISCORDANT EVOLUTION

We committed a still further blunder when we set out on the search for man's ancestry · indeed, some of us are still making it. We expected that man's evolution would pursue not only an orderly file of stages but that every part of his body—skull, brain, jaws, teeth, skin, body, arms, and legs—would at each stage become a little less ape-like, a little more man-like. Our searches have shown us that man's evolution has not proceeded in this orderly manner. In some extinct races, while one part of the body has moved forwards another part

has lagged behind. Let me illustrate this point because it is important. We now know that, as Darwin sat in his study at Down, there lay hidden at Piltdown, in Sussex, not thirty miles distant from him, sealed up in a bed of gravel, a fossil human skull and jaw. In 1912, thirty years after Darwin's death, Mr. Charles Dawson discovered this skull and my friend Sir Arthur Smith Woodward described it, and rightly recognised that skull and jaw were parts of the same individual, and that this individual had lived, as was determined by geological and other evidence, in the opening phase of the Pleistocene period We may confidently presume that this individual was representative of the people who inhabited England at this remote The skull, although deeply mineralised and thick-walled, might well have been the rude forerunner of a modern skull, but the lower law was so ape-like that some experts denied that it went with the human fossil skull at all, and supposed it to be the lower law of some extinct kind of chimpanzee.

This mistake would never have been made if those concerned had studied the comparative anatomy of anthropoid apes Such a study would have prepared them to meet with the discordances of evolution The same irregularity in the progression of parts is evident in the anatomy of Pithecanthropus, the oldest and most primitive form of humanity so far discovered. The thigh-bone might easily be that of modern man, the skull-cap that of an ape, but the brain within that cap, as we now know, had passed well beyond an anthropoid status. If merely a lower jaw had been found at Piltdown, an ancient Englishman would have been wrongly labelled 'Higher anthropoid ape'; if only the thigh-bone of Pithecanthropus had come to light in Java, then an ancient Javanese, almost deserving the title of anthropoid, would have passed muster as a man.

# BLANKS STILL REMAIN IN THE GEOLOGICAL RECORD.

Such examples illustrate the difficulties and dangers which beset the task of unravelling man's ancestry. There are other difficulties; there still remain great blanks in the geological record of man's evolution. As our search proceeds these blanks will be filled in, but in the meantime let us note their nature and their extent. By the discovery of fossil remains we have followed man backwards to the close of the Pliocene—a period which endured at least for a quarter of a million years, but we have not yet succeeded in tracing him through this period. It is true that we have found fossil teeth

in Pliocene deposits which may be those of an apelike man or of a man-like ape, until we find other parts of their bodies we cannot decide When we pass into the still older Miocene period—one which was certainly twice as long as the Phocene—we are in the hevday of anthropoid history. Thanks to the labours of Dr. Guy E. Pılgrim, of the Indian Geological Survey, we know already a dozen different kinds of great anthropoids which lived in Himalayan jungles during middle and later Miocene times, we know of at least three other kinds of great anthropoids which lived in the contemporary jungles of Europe Unfortunately we have found as yet only the most resistant parts of their bodiesteeth and fragments of jaw Do some of these fragments represent a human ancestor? We cannot decide until a lucky chance brings to light a limbbone or a piece of skull, but no one can compare the teeth of these Miocene anthropoids with those of primitive man, as has been done so thoroughly by Dr. William K Gregory, and escape the conviction that in the dentitions of the extinct anthropoids of the Miocene jungles we have the ancestral forms of human teeth.

#### DATE OF MAN'S EMERGENCE.

It is useless to go to strata still older than the Miocene in search of man's emergence; in such strata we have found only fossil traces of emerging anthropoids. All the evidence now at our disposal supports the conclusion that man has arisen, as Lamarck and Darwin suspected, from an anthropoid ape not higher in the zoological scale than a chimpanzee, and that the date at which human and anthropoid lines of descent began to diverge lies near the beginning of the Miocene period. On our modest scale of reckoning, that gives man the respectable antiquity of about one million years.

#### PROOFS OF OUR ANTHROPOID ANCESTRY.

Our geological search, which I have summarised all too briefly, has not produced so far the final and conclusive evidence of man's anthropoid origin; we have not found as yet the human image emerging from its anthropoid encasement. Why, then, do modern anthropoid encasement. Why, then, do modern anthropologists share the conviction that there has been an anthropoid stage in our ancestry? They are no more blind than you are to the degree of difference which separates man and ape in structure, in appearance, and in behaviour I must touch on the sources of this conviction only in a passing manner. Early in the present century, Prof. G. H. F. Nuttall, of the University of Cambridge, discovered a trustworthy and exact method

of determining the affinity of one species of animal to another by comparing the reactions of their blood. He found that the blood of man and that of the great anthropoid apes gave almost the same reaction Bacteriologists find that the living anthropoid body possesses almost the same susceptibilities to infections, and manifests the same reactions, as does the body of man So alike are the brains of man and anthropoid in their structural organisation that surgeons and physiologists transfer experimental observations from the one to the other When the human embryo establishes itself in the womb it throws out structures of a most complex nature to effect a connexion with the maternal We now know that exactly the same elaborate processes occur in the anthropoid womb and in no other. We find the same vestigial structures — the same 'evolutionary post-marks'— in the bodies of man and anthropoid The anthropoid mother fondles, nurses, and suckles her young in the human manner This is but a tithe of the striking and intimate points in which man resembles the anthropoid ape. In what other way can such a myriad of coincidences be explained except by presuming a common ancestry for both?

#### THE EVOLUTION OF MAN'S BRAIN.

The crucial chapters in Darwin's "Descent of\_ Man " are those in which he seeks to give a historical account of the rise of man's brain and of the varied functions which that organ subserves How do these chapters stand to-day? Darwin was not a professional anatomist and therefore accepted Huxley's statement that there was no structure in the human brain that was not already present in that of the anthropoid In Huxley's opinion the human brain was but a richly annotated edition of the simpler and older anthropoid book, and that this edition, in turn, was but the expanded issue of the still older original primate publication Since 7 this statement was made thousands of anatomists and physiologists have studied and compared the brain of man and ape; only a few months ago, Prof. G. Elliot Smith summarised the result of this intensive inquiry as follows. "No structure found in the brain of an ape is lacking in the human brain, and, on the other hand, the human brain reveals no formation of any sort that is not present in the brain of the gorilla or chimpanzee . . . The only distinctive feature of the human brain is a quantitative one." The difference is only quantitative but its importance cannot be exaggerated. In the anthropoid brain are to be recognised all those parts which have become so enormous in the human brain. It

is the expansion of just those parts which have given man his powers of feeling, understanding, acting, speaking, and learning

#### THE EVIDENCE OF PSYCHOLOGY.

Darwin himself approached this problem not as an anatomist but as a psychologist, and after many years of painstaking and exact observation, succeeded in convincing himself that, immeasurable as are the differences between the mentality of man and ape, they are of degree, not of kind. Prolonged researches made by modern psychologists have but verified and extended Darwin's conclusions. No matter what line of evidence we select to follow—evidence gathered by anatomists, by embryologists, by physiologists, or by psychologists—we reach the conviction that man's brain has been evolved from that of an anthropoid ape and that in the process no new structure has been introduced and no new or strange faculty interpolated.

#### UNEXPLAINED PROBLEMS.

In these days our knowledge of the elaborate architecture and delicate machinery of the human brain makes rapid progress, but I should mislead if I suggested that finality is in sight. Far from it, our inquiries are but begun There is so much we Will the day ever come do not yet understand when we can explain why the brain of man has made such great progress while that of his cousin the gorilla has fallen so far behind? Can we explain why inherited ability falls to one family and not to another, or why, in the matter of cerebral endowment, one race of mankind has fared so much better than another? We have as yet no explanation to offer, but an observation made twenty years ago by one on whom Nature has showered great gifts—a former president of this Association and the doyen of British zoologists—Sir E Ray Lankester deserves quotation in this connexion. "The leading feature in the development and separation of Man from other animals is undoubtedly the relative enormous size of the brain in Man and the corresponding increase in its activities and capacity is a striking fact that it was not in the ancestors of Man alone that this increase in the size of the brain took place at this same period -the Miocene. Other great mammals of the early Tertiary period were in the same case." When primates made their first appearance in geological records, they were, one and all, small-brained. We have to recognise that the tendency to increase of brain, which culminated in the production of the human organ, was not confined to man's ancestry but appeared in diverse branches of the mammalian stock at a corresponding period of the earth's history.

# DARWIN'S CONCEPTION OF EVOLUTION ILLUSTRATED.

I have spoken of Darwin as a historian. To describe events and to give the order of their occurrence is the easier part of a historian's task; his real difficulties begin when he seeks to interpret the happenings of history, to detect the causes which produced them, and explain why one event follows as a direct sequel to another. Up to this point, we have been considering only the materials for man's history, and placing them, so far as our scanty information allows, in the order of their sequence, but now we have to seek out the biological processes and controlling influences which have shaped the evolutionary histories of man and ape.

The evolution of new types of man or of ape is one thing, and the evolution of new types of motor-cars is another, yet for the purposes of clear thinking it will repay us to use the one example to illustrate the other. In the evolution of motor vehicles Darwin's law of selection has prevailed; there has been severe competition and the types which have answered best to the needs and tastes of the public have survived. The public has selected on two grounds-first for utility, thus illustrating Darwin's law of natural selection, and secondly because of appearance's sake, for, as most people know, a new car has to satisfy not only the utilitarian demands of its prospective master but also the æsthetic tastes of its prospective mistress, therein illustrating Darwin's second law—the law of sexual selection. That selection, both utilitarian and æsthetic, is producing an effect on modern races of mankind and in surviving kinds of ape, as Darwin supposed, cannot well be questioned. In recent centuries the inter-racial competition amongst men for the arable lands of the world is keener than in any known period of human history.

#### THE PRODUCTION OF NEW TYPES.

The public has selected its favoured types of car, but it has had no direct hand in designing and producing modifications and improvements which have appeared year after year. To understand how such modifications are produced the inquirer must enter a factory and not only watch artisans shaping and fitting parts together but also visit the designer's office. In this way an inquirer will obtain a glimpse of the machinery concerned in the evolution of motor-cars. If we are to understand the machinery which underlies the evolution of man and of ape, we

have to enter the 'factories' where they are produced-look within the womb and see the ovum being transferred into an embryo, the embryo into a fœtus, and the fœtus into a babe After birth we may note infancy passing into childhood, childhood into adolescence, adolescence into maturity, and maturity into old age Merely to register the stages of change is not enough, to understand the controlling machinery we have to search out and uncover the processes which are at work within developing and growing things and the influences which co-ordinate and control all the processes of development and of growth. When we have discovered the machinery of development and of growth we shall also know the machinery of evolution, for they are the same.

#### MACHINE AND ANIMAL EVOLUTION CONTRASTED

If the simile I have used would sound strange in Darwin's ear, could he hear it, the underlying meaning would be familiar to him. Over and over again he declared that he did not know how 'variations' were produced, favourable or otherwise; nor could he have known, for in his time hormones were undreamt of and experimental embryology scarcely born. With these recent discoveries, new vistas opened up for students of evolution. The moment we begin to work out the simile I have used and compare the evolutionary machinery in a motor factory with that which regulates the development of an embryo within the womb, we realise how different the two processes are.

Let us imagine for a moment what changes would be necessary were we to introduce 'embryological processes' into a car factory. We have to conceive a workshop teeming with clustering swarms of microscopic artisans, mere specks of living matter. In one end of this factory we find swarms busy with cylinders, and as we pass along we note every part of a car in process of manufacture, each part being the business of a particular brigade of microscopic workmen. There is no apprenticeship in this factory: every employee is born, just as a hive-bee is, with his skill already fully developed. No plans or patterns are supplied; every workman has the needed design in his head from birth neither manager, overseer, nor foreman to direct and co-ordinate the activities of the vast artisan armies. And yet if parts are to fit when assembled, if pinions are to mesh and engines run smoothly, there must be some method of co-ordination It has to be a method plastic enough to permit difficulties to be overcome when such are encountered and to permit the introduction of advantageous

modifications when these are needed. A modern works manager would be hard put to were he asked to devise an automatic system of control for such a factory, yet it is just such a system that we are a now obtaining glimpses of in the living workshops of Nature.

#### THE MACHINERY OF DEVELOPMENT.

I have employed a crude simile to give the lay mind an inkling of what happens in that 'factory' where the most complicated of machines are forged —the human body and brain The fertilised ovum divides and redivides, one brood of microscopic living units succeeds another, and as each is produced the units group themselves to form the 'parts' of an embryo Each 'part' is a living society, the embryo is a huge congeries of interdependent societies. How are their respective needs regulated, their freedoms protected, and their manœuvres timed? Experimental embryologists have begun to explore and discover the machinery of regulation We know enough to realise that it will take many generations of investigators to work over the great and new field which is thus opening up. When this is done we shall be m a better position to discuss the cause of 'variation' and the machinery of evolution.

#### THE MACHINERY OF GROWTH.

If we know only a little concerning the system of government which prevails in the developing embryo, we can claim that the system which prevails in the growing body, as it passes from infancy to maturity, is becoming better known to us every year. The influence of the sex glands on the growth of the body has been known since ancient times; their removal in youth leads to a transformation in the growth of every part of the body, altering at the same time the reactions and temperament of the brain. In more recent years medical men have observed that characteristic alterations in the appearance and constitution of the human body can be produced by the action of other glands—the pituitary, thyroid, parathyroid, and adrenals.

Under the disorderly action of one or other of these glands individuals may, in the course of a few years, take on so changed an appearance that the differences between them and their fellows become as great as, or even greater than, those which separate one race of mankind from another. The physical characters which are thus altered are just those which mark one race off from another. How such effects are produced we did not know until 1904, when the late Prof. E. H. Starling, a leader amongst the great physiologists of our time, laid bare an

ancient and fundamental law in the living animal body—his law of hormones. I have pictured the body of a growing child as an immense society made up of myriads of microscopic living units, ever increasing in numbers. One of the ways—probably the oldest and most important way—in which the activities of the communities of the body are coordinated and regulated is by the postal system discovered by Starling, wherein the missives are hormones—chemical substances in ultra-microscopic amounts, despatched from one community to another in the circulating blood. Clearly the discovery of this ancient and intricate system opens up fresh vistas to the student of man's evolution

How Darwin would have welcomed this discovery! It would have given him a rational explanation to so many of his unsolved puzzles, including that of 'correlated variations.' Nor can I in this connexion forbear to mention the name of one who presided so ably over the affairs of this Association fifteen years ago-Sir E Sharpey-Schafer was the pioneer who opened up this field of investigation and has done more than anyone to place our knowledge of the nature and action of the

glands of internal secretion on a precise basis of With such sources of experimental observation knowledge being ever extended, and others of great importance, such as the study of heredity, which have been left unmentioned, we are justified in the hope that man will be able in due time not only to write his own history but also to explain how and why events took the course they did

In a brief hour I have attempted to answer a question of momentous importance to all of us-What is man's origin? Was Darwin right when he said that man, under the action of biological forces which can be observed and measured, has been raised from a place amongst anthropoid apes to that which he now occupies? The answer is Yes! and in returning this verdict I speak but as foreman of the jury—a jury which has been empanelled from men who have devoted a lifetime to weighing the evidence. To the best of my ability I have avoided, in laying before you the evidence on which our verdict was found, the rôle of special pleader, being content to follow Darwin's own example—Let the truth speak for

#### Scientific Problems and Aspects.

SUMMARIES OF ADDRESSES OF PRESIDENTS OF SECTIONS.1

OUTSTANDING PROBLEMS OF RELATIVITY.

IN his presidential address to Section A (Mathematics and Physical C. matics and Physical Sciences), Prof. E. T. Whittaker refers first to the remark made by FitzGerald in 1894 that "Gravity is probably due to a change of structure of the æther, produced by the presence of matter," and discusses the relation of Fitz(lerald's views to Einstein's theory of gravitation He then describes some of the consequences of general relativity, other than the well-known bending of light-rays by the sun and gravitational shift of spectral lines follow on the number of unsolved problems of the statical type, for which only the ordinary threedimensional analysis is required, and which may therefore be attempted by those investigators who distrust their own powers of doing research in four dimensions. Reference is also made to connexions with the new wave-mechanics

Prof. Whittaker then examines successively the relation of geometry to physics, and the place of electromagnetic phenomena in general relativitytheory, referring to the non-Riemannian geometries

which have been suggested by Weyl, Eddington, Schouten, Wirtinger, and others.

This is followed by an inquiry into the axiomatics of the subject. The usual way of introducing relativity is to talk about measuring-rods and clocks, but Prof. Whittaker disapproves of this, and considers that the notions of 'length of material bodies' and 'time of clocks' are really rather complex notions which should not be introduced into the earlier chapters of axiomatic physics. He begins instead with the tracks of light-rays and of particles in the field, and shows how from them it is possible to construct the quadratic differential form which lies at the basis of the analytical theory, without introducing the notions either of length or of time. The next step is the assertion that the laws of Nature must be represented by equations which are covariantive with respect to this quadratic form with respect to all point-transformations of co-ordinates: after which the development of the theory proceeds in the usual way By this procedure we obtain a geometry which is based entirely on light-rays and paths of particles, leaving open the question whether this is, or is not, identical with the geometry based on rigid measuring-rods The results of the ether-drift experiments of

 $<sup>^1</sup>$  The collected presidential addresses delivered at the meeting are published under the title "The Advancement of Science 1927," at 6s, or may be obtained at the bookstall at Leeds by members for 4s, 6d

D C. Miller at Mount Wilson in 1925, if confirmed, would seem to indicate that the two kinds of geometry are actually different

Prof. Whittaker then discusses the place of minimum-principles in physics. Gravitation acts so as to make the total amount of the curvature of space-time a minimum or, as we may say, gravitation simply represents a continual effort of the universe to straighten itself out. This is general relativity in a single sentence. He then examines the Mach-Einstein doctrine that the metric of space-time is determined wholly by the masses and energy present in the universe, so that space-time cannot exist at all except in so far as it is due to the existence of matter. Finally, reference is made to the De Sitter world and the difficulty of estimating the radius of curvature of the universe.

#### Co-ordination Compounds.

DR N. V. SIDGWICK points out in his presidential address to Section B (Chemistry), how the apparent contradiction between the principles of structural chemistry and the theory by which Werner accounted for the composition and properties of his co-ordination compounds was resolved by means of the electronic conception of valency. co-ordinate link is clearly from its behaviour a form of covalency (non-ionised link), consisting in the sharing of a pair of electrons between the two linked atoms; but whereas in the normal covalency one of the two electrons is derived from each atom. and so the number of links formed depends on the periodic group to which the atom belongs, in the co-ordinate valency both electrons are derived from one atom, which removes this limitation, and the maximum covalency or co-ordination number is the number of pairs of electrons in the maximum valency group.

The formation of a co-ordinate link thus requires the presence (a) of an atom (the donor) with two unshared valency electrons to lend, and (b) of another atom (the acceptor) capable of taking them up. The link so formed is less stable than an ordinary covalency, owing to the greater stability of the products of its rupture, and it also communicates a dipole character to the molecule (the donor having something of a positive and the acceptor something of a negative charge), which leads to an increase in the dielectric constant and a diminution of the volatility. It is by the formation of these links that liquids become associated, and accordingly we always find in the molecule of an associated liquid a donor and an acceptor atom, in the commonest case of the

hydroxyl group, the oxygen of course is the donor and the hydrogen the acceptor. This explains the anomalous position of such compounds as amines and ethers, which behave like associated liquids in some ways but not in others: they contain donors (the nitrogen or the oxygen) but no acceptors, and hence cannot associate with themselves or with non-associated substances, but can do so with associated substances, because the latter contain the requisite acceptor atoms

The occurrence of co-ordination compounds is thus by no means confined to the Wernerian complexes, but is widely distributed throughout organic as well as inorganic chemistry essential to recognise the importance of this factor in chemical reactions, especially in relation to the modern intensive study of reactivity in organic compounds The unique position of carbon, on which the very existence of organic chemistry depends, can only be understood by reference to the theory of co-ordination its mertness in its saturated compounds (to which the number and variety of these compounds is largely due) depends on the fact that the quadrivalent carbon atom, with a completely shared octet incapable of further expansion, can act neither as donor nor as acceptor

The further development of our knowledge of the influence of co-ordination on reactivity involves in particular the investigation (1) of the effect of other atoms in the molecule on the tendency of an atom to exert its donor or acceptor properties—on its power of forming co-ordinate links—and (2) of the extent to which the formation of co-ordination compounds is an intermediate stage in chemical reactions

#### TERTIARY VOLCANIC ACTIVITY IN BRITAIN.

DR HERBERT H THOMAS'S presidential address to Section C (Geology) is concerned with the British. Tertiary centres of intrusion, more particularly with the plutome and hypabyssal rocks. Local subsidence is the chief factor in the determination of the sites of the major intrusions, which subsidence has allowed the uprise of magma from the great intercrustal basin that supplied the plateau-basalts. The ring-dyke and the stock are the dominant forms adopted by the main intrusive bodies and the two are closely related in origin. Laccolites in the true sense are practically unrepresented, as might be expected in regions that have been affected by tensional rather than compressional forces.

The sequence of events as established by recent

work in the respective centres, and the mutual relations of contiguous intrusive masses, are dis-In unravelling the structure of an igneous complex, emphasis is laid on the importance of screens—those narrow masses of older rocks that completely or partially separate otherwise contiguous intrusions of ring-dyke type. As regards the origin of the various rock-types, the view is taken that they are all derived from a magma of basaltic composition by a process of differentiation which is primarily dependent on the separation of crystalline phases In agreement with Dr. Harker, however, Dr Thomas holds that the general order of intrusion, that is, from basic to acid, could not be maintained without the remelting of an already differentiated density-stratified, or completely Contamination has played no solid magma appreciable part in modifying either the primary or subsequent magmas, and no variations of rocktype among the major intrusive bodies can be attributed to this cause.

#### ANCIENT HISTORY OF ANIMALS.

In his presidential address to Section D (Zoology), after discussing indications of a pre-Cambrian cataclysm, Dr. Bidder considers the conditions of originating life, and suggests that protein adds to itself rhythmically, alternately accumulating energy from the environment and expending it on the formation of a new molecule. This rhythm of energy would be accompanied by a rhythmical expansion and contraction of volume. Evolution of the flagellate consisted in the formation of a permanent filament of protoplasm characterised by having one side more gelated than the other side. Thus the rhythmic expansion in volume caused a rhythmic convexity of the more extensible side, followed by an elastic counterstroke at the moment of synthesis and contraction The rhythm of storage of energy alternating with synthesis has never been lost, and is the foundation of our sense of time and of the phenomena of age and senile death.

The mucilaginous exudation of flagellates enables their longitudinal fission to produce sheets of coherent cells, often curved until they form closed 'hilospheres.' In such a closed sphere exudation cannot escape from the central cavity, so that if the cellular envelope be permeable, the tension of its walls and of its surface are opposed by the osmotic pressure of its contents. Should the cells of a hilosphere or blastosphere at any time withdraw salts, proteins, or sugars from the gelatinous interior, so as to make it hypotonic

to the external water, water will pass out and invagination will take place.

In certain strains of flagellates the cells of the envelope, behaving as do Metazoan cells in vitro, proliferated cells into the internal jelly, which thus became capable of transformation into the inter-epithelial parenchym of coelenterates and true sponges, the mesenchym of larvæ and the tissues of the higher Metazoa. This tendency is shown in Proterospongia, but is not usual in colonial choano-flagellates, and it is not shown in hexactinellid sponges, which must therefore be distinguished as Porifera nuda from the Porifera vera the collar-cells of which are based on jelly. The Clavulida, Desmacidonida, and Renierida show triaxon symmetry in their spicules (cf. NATURE, Feb 28, 1925, vol 115, p 298), and are probably descended from Hexactmellida They may be grouped together (probably with the Axinellida) as the Orthogonida. The Portfera vera include Tetraxonida s.s., Ceratosa, and Calcarea, from these last the Enterozoa may be descended.

Sponges are multicellular organisms specially adapted to bring to each flagellate cell a number of minute organic particles suitable for intracellular digestion, and to exclude larger fragments. In no sponge can the sponge's current carry a body larger than a human blood-corpuscle into the flagellate chamber, and in most the entrance pores of the chambers will not admit a particle one-third of this diameter. Therefore sponges are older than Enterozoa, which are evolved to digest large fragments, and must have originated after there existed cellular aggregates large enough to require a stomach to attack them. If Enterozoa be descended from sponges, they may both still be united in the kingdom Animalia; if they are not so descended the sponges must be recognised as a third kingdom of multicellular organisms, the Microphaga, specialised for the intracellular digestion of living organisms less than  $5\mu$  in diameter

#### SOME PROBLEMS OF POLAR GEOGRAPHY.

Dr. R. N. Rudmose Brown, in his address to Section E (Geography), deals first with some problems in the physical geography of polar regions. The attainment of the poles has not put an end to the need for exploration, but has rather given an opportunity for work in the future being concentrated on specific problems. In the Antarctic, the two great problems are the discovery of the outline of the continent, the existence of which is still based on circumstantial evidence, and the elucidation of its structure and relations to the

other southern continents. The relationships of the contrasted structures of Victoria and Graham Lands are discussed at length Further problems of importance awaiting solution are the peculiar Antarctic blizzards and the general circulation of air over the continent, especially with reference to the alimentation of the ice-sheet

In Arctic regions there are no pioneer problems of equal magnitude, and though no extensive land is at all likely to be discovered, there is the possibility of several reports of islands having some foundation in fact. These are discussed in full. Of more importance is the oceanographical exploration of the Arctic basin and the explanation of its origin as an earth feature. The circulation of Arctic waters and the distribution and fluctuation in amount of ice discharged into the Atlantic are problems with a practical bearing on the weather of the British Isles.

In discussing the methods of exploration, Dr Rudmose Brown sees little value in the aeroplane for the detailed scientific work that is now required in polar exploration, except in the survey of difficult country lying within easy reach of a base accessible by sea transport and provided with good landing places. Amundsen's daring flight across the Arctic Ocean had few important geographical results. In the Antarctic, where much pioneer work has still to be done, aeroplane flights may be of some value, but a forced landing would probably spell disaster

The last part of the address is concerned with a discussion of the possibility of settlement and colonisation in Arctic lands. This entails an examination of Mr. V. Stefansson's glowing picture of the future of the Arctic prairies of Canada, and the fate of the old Norse colonies in Greenland. As pressure on the world's food resources becomes greater, pasture land in temperate lands will become scarce. Then the value of Arctic prairies for reindeer and musk-ox will be realised. Herein lies the probability of a gradual invasion by the white races of the outer rim of the Arctic as the native races of Siberia and northern Canada die out before the flowing tide of civilisation. Climate offers no real impediment to Arctic settlement.

#### ORGANISATION IN INDUSTRY.

Prof. D. H. Macgregor's address to Section F (Economic Science and Statistics) on "Rationalisation of Industry" consists of a review of the questions raised by the claims of highly organised industrial combinations to control and steady the evolution of industry. Attention is first directed to the change of opinion which has taken place in the post-War period as regards such combinations, which were regarded with much less favour before the War. The creation of such great structures as the European steel cartel has reacted on the views held in each country, since national organisation is a condition of international agreements of this kind.

The conception of rationalisation is presented as one which makes in industry for the application of the idea of government, and of the leadership of those most qualified to govern. The 'cartel,' the 'trust,' and the 'concern' show different aspects of this conception. The idea of the government of an industry as a whole, as distinct from the less organised relations of competitive producers, is borrowed from political affairs, and the question, how far it is applicable to the field of industry should be discussed by bringing also into the argument such other types of government as the ecclesiastical and the military

Industry is not alone in not having been able to apply the political type of administration, the sphere of, for example, authority being greater in other non-political spheres than in industry. Some ideas are common to the conception of government anywhere, such as the completest range of control, and the control of what hes on each side of the main interest—and these appear in industry as the tendency toward monopoly, and toward the vertical union of successive stages of production. But the special conditions of the industrial sphere, private liability and risk, are unique

The organisation of 'combines' shows that many advantages could follow in respect both of the technical evolution of capitalism, and its relation to labour. But what is most rational in the way of higher organisation in industry is to be found rather in a proper balance, something being sacrificed from the unity of a complete government on one hand, and on the other hand from the 'Ricardian rationalisation' which works out through the adjustment of success and failure. Industry is not to be subsumed simply under the conceptions of government which are valid elsewhere, but must-find out what degree of unity in administration in consonant with its unique conditions.

#### DISCOVERY AND INVENTION

SIR JAMES B HENDERSON, in his presidential address to Section ( Engineering), deals with "Invention as a Link in Scientific and Economic Progress" Discovery and invention are so closely allied that they are frequently confused, and in common speech the two words are often used synonymously. No clear distinction can be drawn between them except in such general terms as that discovery begins and ends as a mental conception forming an addition to man's abstract knowledge. while invention, although also a mental conception in its origin, is essentially material, masmuch has it is a conception of some practical application knowledge Discovery and invention bear therefore towards each other more or less the same relation as exists between theory and practice, between the abstract and the concrete

Both are alike, in that although possibly the result of an instantaneous flash of inspiration, or possibly of an accident, or it may be, the result of long and tedious study, great discoveries and great inventions can seldom be considered complete until much time and effort have been spent on their confirmation or development. This latter period of their history generally demands also the expenditure of large sums of money, so that we find in discovery, invention, and finance, a union of three factors allied in the service of man.

Invention, considered by itself as a link in progress, is a peculiar combination of an exact science, such as engineering, physics, or chemistry, with a historical science, like the science of war or of economics. The latter are studied as sciences, though based in no foundation of physical laws The science of war is studied historically from records of the tactics, strategy, successes, or failures of old campaigns, such records being kept with meticulous care in official records for the benefit of the soldiers of to-day But in the science of invention no such records exist, with the result that in the war between the inventor and Nature the same mistakes recur again and again, and many an invention fails from lack of any historical record or intelligence service such as guard the soldier against repetition of the mistakes committed by other generals of the past In other words, the inventor starts from scratch, yet there must be, or must at some time have been, an enormous volume of technical knowledge which, were it only available, would aid greatly in the rapid development of his invention and would possibly turn some of the failures into successes Is there no way to bring this accumulated knowledge to light? Much of it is necessarily lost because those who possessed it have died without leaving any record of their knowledge. But can we not start now to remedy this defect and to prevent its perpetuation?

Much could be done if science could be taught historically in our schools and colleges this the great impediment is time. So much has already to be crowded into the short course of scientific study that no time is left for the study of the history of a science. Possibly something could be done by legislation through alteration of the Patent Acts to bring the history of an invention, with all its difficulties and their conquest, within the description of the invention published in the patent specification. This would necessitate discrimination between minor inventions which can be rapidly and easily developed, and the major inventions which form the milestones in scientific progress. The development of these cannot possibly be achieved, or the difficulties overcome, within the short period of nine months within which a supposedly complete description of the finished invention has to be filed. A third remedy lies in the hands of the British Association and other kindred bodies, to whom it is open to invite inventors to contribute a historical record of their inventions, whether successful or unsuccessful, and particularly a record of the difficulties which they encountered in the process of development. Such records, which could be published in the proceedings of the technical societies at a time selected by the authors, would furnish a nucleus of an invaluable library of a kind which does not exist to-day, and would be of incalculable assistance to the inventor and the scientific worker of the future

#### THE ENGLISHMAN OF THE FUTURE

PROF F. G PARSONS, in his presidential address to Section H (Anthropology), deals with

the knowledge which he has gained of the way in which the Englishman has changed during the centuries, and, considering these changes, he suggests their probable effect in building up the Englishman of the future.

With regard to height, the well-nourished Englishman of to-day averages 5 ft 9 in.; and, because he has done so steadily for the last twenty years, it is thought that this height is the limit which English males will reach With English women, on the other hand, height seems to be increasing year by year, and there is no reason therefore to think that the present average of 5 ft 5 m for women of the well-nourished classes will not be passed by two or more inches regard to colour, when the statistics of to-day are contrasted with those left us by Dr. Beddoe, sixty years since, the present observer has to admit that he finds no sign of darkening of either hair or eye colour, but that, in every case, the change, though slight, is on the side of fairness. In these two factors of colour and height, therefore, there is reason to think that, so far from the Nordic characteristics of the English people disappearing, they seem to be increasing

In dealing with head shape, it is important to take into account the head height as well as the cephalic index, which alone is not sufficient to indicate what is happening. The length, breadth, and height of the head can be expressed in terms of the sum of all three, and the variations of these ratios, from the earliest Neolithic times to those of the present day, can be demonstrated. One of the most striking facts brought out by this method is that during the last two centuries the English skull has been increasing very markedly in height, even in the poorly educated classes of the community, while in the more highly educated, which have been influenced most by modern hygiene, the increase is really startling, and the head height is much greater than that which any of the races from which the modern Englishman is derived can show. The inference is that environment, rather than heredity, is influencing the head shape, and that the Englishman of the future will have a head quite different in shape from that of any of the ancestral races from which he is descended. With the shape of the head, of course, that of the brain is changing too, and this cannot be without its effect upon the mental characteristics of the Englishman of the future

#### THE DEVELOPMENT OF HUMAN PHYSIOLOGY

The last fifty years have witnessed the great extension of the method of physiological investigation by means of direct experimentation on animals, a method which may be termed the analytical method since the organism is treated as a series of systems which, though but parts of a whole, are yet capable of being regarded within limits as independent Valuable though this method has proved, and will continue to prove in the future, Dr C. G Douglas, in his presidential address to Section I (Physiology), points out that we must recognise that it has in

reality definite limitations, and if we are to understand life we must ultimately adopt methods of investigation which do not interfere with the normality of the organism or its natural powers of self-maintenance

In the study of normal physiology, man is in many instances a more advantageous subject of investigation than are the lower animals, because we can ensure the maintenance of any degree or type of natural activity that we may desire, we can obtain the co-operation of the subject, and we can learn his subjective impressions. This claim can be justified by a review of the experimental work which has already been done on the human subject in many branches of physiology; for example, in the study of the general energy output under different conditions of normal activity, of the regulation of the respiration and circulation, of the function of the kidneys and of the alimentary canal, while we owe much m other fields to m-, vestigations undertaken primarily in the cause of clinical medicine The outstanding contributions to knowledge which we owe to human physiology are the quantitative changes of organ activity associated with normal life, the close functional linkage of the different organs, and the power of adaptation to altered circumstances.

We have learnt something of what really characterises normal life, and we have been put in a better position to make use of the information obtained by the analytical method of investigation of the lower animals, which by itself affords, as a rule, evidence of potentialities rather than actual-

ities.

The development of human physiology is already sufficient to justify greater prominence being given to this subject in our teaching of physiology, and this is especially true of practical courses of instruction. Many students only take a course of elementary physiology as a preliminary to the study of medicine, but it is not difficult to incorporate even in an elementary course simple experiments in human physiology which, by allowing the student to appreciate something of what happens in his own person in the course of everyday life, will awaken his interest and curiosity, and by giving him a guiding line of thought will help him to grasp more readily the significance of what he reads. Unless the student can gain some real conception of the way in which physiology is helping to elucidate the phenomena which characterise normal life, there is a risk that a gulf, for which there can be no justification, will deepen between physiology and medicine.

#### MENTAL UNITY AND MENTAL DISSOCIATION.

It is significant that the problem of unity and dissociation occurs in many forms in current physical, physiological and psychological spheres. Even in psychology alone, various doctrines have caused controversies as to the answer to be given to the question. What is unitary and what is multiple? Thus the Gestalt psychologists stress the unity of a presentation or pattern. Another

notable instance is the question of the purity c 'general mental energy 'as a mental content

In abnormal psychology the problem presents characteristic form Dr W. Brown, in his presi dential address to Section J (Psychology), points out that Pierre Janet and Morton Prince in the hypnotic period of psycho-pathology developed the concept of mental dissociation, and a char acteristic feature of this period is the frequence with which cases of multiple personality wer discovered Dissociation, for Janet, is the fundamental and all-important feature of neurot disorders It is true that in the writings of Free and Jung the word 'dissociation' seldom occur its place being largely taken by the term 'repre But it is characteristic of Dr. Brown's vie that both unity and dissociation are regarded a aspects of the normal nund; both are ultimat In his latest book, "Mind and Personality" Dr. Brown points out that recent discussions : personality stress the multiplicity—" looking for unity as a result of interaction between the mar, instead of regarding the unity as somethin ultimate '' He admits that the unity of the developed adult mind is to a great extent ai acquired unity, but holds not only that ultimately we are multiple as well as unitary, but also than the feeling of unity is present at every moment of consciousness

Lest such a view be regarded as an insignificant platitude, it may be noted that cases of multiple personality are no longer on record among the psycho-analysts of to-day, who have replaced hypnosis by deep analysis, or autognosis as Deserving Brown prefers to call it, the reason being that the hypnotic method tended to produce multiplicity, whereas autognosis is a process of unification. There is actual development of the mind going on during the process towards the normal and the unitary. Any dissociation that is encouraged by the method is a normal dissociation, any dissociation that is overcome is a pathological dissociation or repression, that is, a dissociation

that is not complete or thoroughgoing.

In an attempt to interpret character and personality along these lines, Dr. Brown is therefore unable to accept McDougall's theory of the self as a system of monads which form a hierarchy, in which there is one dominant monad, the conscious self, and a number of subsidiary monads that are, in a normal mind, adequately subordinated to the chief monad and are in relation to the chief monad through telepathy, but in a case of multiple personality, one of these subsidiary monads may break loose and become insubordinate. (In such highly hypothetical matters differences of opinion are inevitable In many respects, however, Dr Brown is in agreement with McDougall. It no scarcely be said that both hold that a biolo which neglects psychology is incomplete, as unity of the organism becomes more intelligi when we think of it as a mental, and in part, a conscious, unity. The ultimate factor is a purposi general striving, which must be assumed in org to account for the theory of conditioned reflexes

EARLY BEGINNINGS OF PLANT LIFE

For F E. Fritson's address to Section Botany) deals with "Some Aspects of the ent-Day Investigation of Protophyta" A study ne simpler Algæ and holophytic Flagellata is arst importance, since they afford the only crial upon which we can base views of the early nnings of plant-life and the mode of origin of olant-body. The modern outlook with respect nese organisms dates from the distinction some tly years back of the Green (Isokontæ) and thw-green Algæ (Heterokontæ), as phyla originaa from separate flagellate ancestries ores differ in certain morphological features, but a) fundamentally in physiological characteristics ortid-pigments, products of photosynthesis, etc.) n he same basis nine further classes of pigmented o phyta are recognisable, representing as many vationary lines. The old distinction between as and Flagellata is no longer tenable, since Lous classes of the latter (Chrysomonadmeæ, (idinieæ, Cryptomonadineæ) have been shown to Isess true algal representatives It is probable at each series of holophytic Flagellata might ve advanced to algal organisation, although ne (Euglenineæ, Chloromonadineæ) have aparently failed to do so. The acquisition of algal haracteristics (cell-wall, sexuality, etc.) has ensued different levels in the different classes, thus, in he Heterokontæ and Chrysophyceæ the motile Inicells and the palmelloid types are Flagellates, Abulst in the Isokontæ the same forms are ievalently algal.

There is evident a far-going parallelism (homolasy) between the classes of pigmented Proto-hyta. The same types of construction (unicelluter, colonial, filamentous) recur repeatedly and are a part represented by astonishingly similar forms. Evolution has clearly progressed along analogous ines in each class and, except in four (Bacillariales, Pryptophyceæ, Euglenineæ, Chloromonadineæ), has bulminated in the branched filament. The highest Isokontæ (Chætophorales) possess a plant-body differentiated into a system of prostrate threads and a branched projecting system. The same type of thallus is found in the simplest brown and red seaweeds, most of which are nevertheless far more elaborate. The green Algæ thus terminate blindly at the level at which the two great marine

In view, however, of the extreme capacity for morphological elaboration and for adaptation to very diverse habitats (including terrestrial ones) shown by the Isokontæ, a failure to develop further in the direction generally inated by the Phæophyceæ and Rhodophyceæ is conceivable; moreover, their photosynthetica inpment is that characteristic of land-plants, is implies that, approximately at the level of orphological differentiation and stature reached the Isokontæ, the terrestrial habit was adopted ad that the more advanced green Algæ have been cost because they became land-plants. The many analogies that can be traced between Phæophyceæ

and Rhodophyceæ on one hand, and land-plants on the other, are to be regarded as a natural outcome of the general evolutionary trend in the vegetable kingdom. As regards the alternating generations, so characteristic of land-plants, the evidence for or against their occurrence in the higher green Algæ is at present quite inadequate, and parallel cases to that of Pylaiella among the Ectocarpales are perhaps yet to be found in the Chætophorales.

The address concludes with remarks on the methods of investigation of the simpler Algæ. The limitations of pure cultures are discussed and a direct periodic study, especially of the filamentous types, advocated Attention is directed to the extremely backward position of Great Britain as regards fresh water biological stations and the urgent need for the establishment of a well-staffed and properly equipped station on the Norfolk Broads emphasised.

#### BROADENING THE EDUCATIONAL OUTLOOK.

In her presidential address to Section L (Educational Science), the Duchess of Atholl deals with the point emphasised in the recent Report of the Board of Education's Consultative Committee on the Education of the Adolescent, that the wide variations of capacities and gifts among the large number of children in the schools can only be met by a wide variety of courses of instruction.

After briefly reviewing the broadening curriculum, both in school and university the Middle Ages, she points out that it is only within the last twenty or thirty years that there has been established a fairly balanced secondary curriculum in literary and scientific subjects, and that it is not surprising, therefore, that the progress of handwork as an instrument of education has been slow. But handwork, with its appeal to the child's creative interests, can be equally helpful laying the foundations of cultural developments of the child's as reading, writing, and arithmet.

So far as secondary schools are concerned, it was only in 1912 that the Consultative Committee recommended that every secondary school should provide for the teaching of some branch of educational handwork. As regards elementary schools, the same Committee reported in 1905 in favour of schools which would combine a general education with some practical instruction in a course extending up to 15 years of age, while the Education Act of 1918 has made it obligatory on education authorities to provide practical and advanced instruction for older scholars either in central schools and classes or otherwise.

Although the need for a wider curriculum, including practical work, has thus clearly been recognised, the present position can scarcely be regarded as satisfactory. There is still too great a tendency to pass on as many children as possible to the ordinary secondary school where the curriculum, however well adapted for boys and girls of scholastic ability, may be quite unsuited to pupils of another type, leaving school at about 14 or 15

of age. The reasons for the neglect of principal training have been various, but principal pally here has been a failure to appreciate the psychogical issues involved Practical work is one was of securing the interest of the child, and there wan be no intellectual development without internand understanding. This truth does not merch apply to the younger children, as recent psyconogical tests have shown that the need for the conty of curriculum mereases with adolescence. Per curl instruction is not merely desirable for the i backward, in whose case its worth is generally recognised, it is necessary for those chili who have a non-verbal or practical ability which may be quite equal to the normal and yet fall to now itself in the ordinary lessons of school By agoviding an outlet for this practical ability, confidence is gained which reacts with good results on the ordinary school work
Further, it is important to remember that

practical instruction is an element in character training tapping fresh sources of energy and forming a wholesome corrective for the On educational grounds alone, therefore, at the post-primary stage there is need for the greatest variety of courses and for courses

including practical instruction.

Such instruction is also required from the point of view of social and economic welfare. Practical will engender adaptability and will produce

girls who will not regard the clerical ions as the only avenue open to them, but will be ready to take their place in industry and will have the mitiative to avail themselve opportunities offered by our Empire overseas. will further assist in that important part of education-training for lessure; while, in so far as handwork is often co-operative, it will remforce that raining in the team spirit which is inculcated school games and school life generally.

st important task of education in the ruture is to develop new forms of postinstruction which shall not be a mere imitation or rival of the ordinary secondary school, but will offer to every child a chance of developing its special ability as well as of acquiring general culture. Many difficulties have to be faced eachers but if this aim can be kept clearly in view, progress will be sure, and we shall be able so to frame our system of education as to bring to the service of the community in its varying needs rich cutributions of equally varied ability

#### AGENULTURE AND NATIONAL EDUCATION.

SEVERAL aspects of agriculture in its relation to education are discussed in Mr. C. G T. Morison's presidential address to Section M (Agriculture) He deals arst with the provision of technical and vocational training in agriculture, he points out that no system can be regarded as complete which fails to make provision for the instruction of all three partners in the industry, no system can be prompted as satisfactory which is not more com-

pletely utilised than the present. vision of technical education for the landlord and the farmer has been satisfactori, developed, manual worker, upon whose sl. ' ... efficiency of the business more th finds little or no opportunity for

It is suggested that one reason technical education and research full effect upor the agricultural in fact that many farmers and all To obviate this it would be necessary to ensure the something in the nature of general education, university type should 1 available throughout t country districts, so that cultural education application applicat from vocational training, could be continued to much later age than at present. It is hold the before it is possible to make a faller use of th technical instruction which is, or can be provide a it is necessary to arouse the desire for it, forth it is necessary to create and muntain a mo receptive mind

WINE W

The present unsatisfactory condition of the agricultural industry demands some definite polici and this can only be achieved if there is a great understanding of the needs of agriculture b the whole population, urban as well as rure Justification for this widening of agriculture education is to be found in the fundamental in portance to the nation of a flourishing agricultur. In the opinion of certain authorities, the day is no far off when not only Great Britain but also countries hitherto food-exporting will have to consider the framing of a definite national agr cultural policy in the interests of the whole population lation. If Sir Daniel Hall and those who thing with him are right, the time will shortly come whe the demands of an increasing population will make intensification of production inevitable. Thus continued scientific investigation is necessary in order to produce this result will only be realised by that nation which includes some knowledge of agriculture and food production in the natic education of its citizens.

It should be possible by broadening the basis of scientific education to bring it none into touch with the realities of life. This could be achieved by developing, from the most elementary nature study, a conception of scientific training which would meet all the requirements of the ordinary man, and would enable him to have a reasured and informed opinion about the most fundamental of all industries, and the various problems of the food supplies of the modern world food supplies of the modern world As a purely educational and non-vocational study agriculture is a suitable university subject if it be not confined. as hitherto, almost entirely to the sule cophysical science, but developed to include a star of current agricultural conditions throughout the world, and of economic science in its application to periculture The world situation to-day demands formation tion on this subject among educated ; the precarious position of the industry in Circles Pritains, demands a sympathetic understanding. Buth of these demands can only be meaby fuller calucation

# Nature

#### A WEEKLY

# ILLUSTRATED JOURNAL OF SCIENCE

JULY, 1927, to DECEMBER, 1927

"To the solid ground
Of Nature trusts the mind which builds for aye."—Wordsworth.

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